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(Continued)

Afternoon Session, Saturday, December 31, 1921, 1.30 p.m.

PRESIDENT GEORGE A. DEAN: The first paper on the program is entitled "The Argentine Ant in Mississippi," by R. W. Harned and M. R. Smith.

ARGENTINE ANT CONTROL CAMPAIGNS IN MISSISSIPPI

By R. W. HARNED and M. R. SMITH

Fourteen years ago at the Chicago Meeting of the American Association of Economic Entomologists, Wilmon Newell, then of Louisiana, began a paper on the Argentine ant with the following remarks:

"It is not often that the economic entomologist is privileged to behold the coming of a new and dangerous pest, to see its numbers rapidly increasing for several years before it attracts more than casual attention from the 'layman,' and yet be practically powerless to avert the threatened catastrophe.

An insect problem practically unheard of by the majority of the members of this Association, is now presenting itself in the State of Louisiana, and will shortly present itself to most if not all of the southern portion of this country. It is, withal, a problem which in the writer's humble opinion will rank in magnitude alongside the problems presented by the San Jose scale, gypsy moth and boll weevil, but in marked contrast to these it is not likely to admit of remedial measures being as easily applied.

In his brief experience as an entomologist, the writer has not encountered or heard of any species which exercises its destructive abilities in so many different directions. As a household pest I venture the opinion that this ant has no equal in the United States. It is both a direct and indirect enemy of horticulture; direct by actual destruction of buds, blooms and fruit, and indirect by its fostering care of various scale insects and plant lice. In the latter role it becomes also an enemy of importance to shade and ornamental trees and plants. By its association with *Pseudococcus calceolariae* (Mask.) it may wipe out, or at least make unprofitable, the production of cane sugar in the South. By its successful antagonism of beneficial forms it becomes doubly injurious."

Although these statements were made fourteen years ago and this pest has been under observation in Mississippi during the years since then, the writers do not feel that they can improve on Newell's description of the injurious nature of this insect. As a prophet, however, he was not quite so accurate in predicting that the Argentine ant would not be likely to admit of remedial measures being as easily applied as for the San Jose scale, gypsy moth and boll weevil. In our opinion the remedy[1] that has been developed for the control of the Argentine ant compares favorably with the remedial measures that have been discovered for any of the insects with which it was compared.

The first Argentine ants were probably brought into Mississippi from Louisiana over 20 years ago. Twelve years ago there were about a dozen towns in the state that were known to be infested. The number of infestations has gradually increased from year to year until at the present time there are over forty different towns that are known to be infested. There are probably more that have not been recorded, as complaints seldom reach us until the ants have been present for several years and have become firmly established. All the entomological workers in the state have during the past year been on the lookout for new infestations. The nursery inspectors always look for the Argentine ant when inspecting nurseries, but so far this pest has not been found in any nursery in the State. Of its own accord the ant spreads in all directions only a comparatively short distance—not more than a few hundred yards each year. It makes "commercial jumps." This accounts for its appearance in practically all of the larger towns in the state, and investigations indicate that the ant generally first becomes established in a town near the freight depot or in the wholesale district.

During the past two years the Plant Board in Mississippi has been putting on Argentine ant control campaigns in cooperation with the various towns. Usually we receive complaints in regard to this pest from a few individuals and organizations. The people in the infested areas want help. We notify them that upon request of the Mayor we will send a man or two to make the preliminary survey at no cost to the town. Of course, a prompt and cordial invitation is usually received from the Mayor. We do not want to appear to be forcing ourselves upon any community. If any disgruntled citizen does not like it because we are looking for ants on his trees and fences, we can simply explain that we are there at the request or invitation of the Mayor of the city. In making the preliminary survey we map the limits of the infestation,

[1]The remedy is discussed in Farmers' Bulletin No. 1101 entitled "The Argentine Ant as a Household Pest," by E. R. Barber.

then estimate the number of cans of poisoned syrup necessary for each block. This is usually between 150 and 200 cans, depending upon the size of the block, the number of trees, and the degree of infestation.

After the preliminary survey has been made we furnish the city authorities with a detailed estimate of the cost of the Argentine ant campaign. Experience has shown that one of these campaigns will cost about $75 for each thousand cans of syrup that are used—this includes cost of cans, syrup, sponges, freight, express, drayage, labor, lumber, and nails.

The Plant Board furnishes men to supervise and to do a large part of the actual work. The city pays for everything except the salaries and expenses of the Plant Board men. Two working together as a field party are expected to put out from 600 to 700 cans in an eight hour day. One man in a Ford car can ordinarily keep 5 field parties supplied with cans of poisoned syrup. To do this, at least two fast workers are needed at the filling station. They must place the sponges in the cans, crimp the cans on two sides, fill the cans with syrup (usually about ⅔ full) place the tops on the cans, and place them in baskets. Each basket holds 48 cans. Usually about 6 baskets are carried to the field on each trip by the automobile. The man in the car has a map of the city on which is indicated the estimated number of cans needed for each block. He instructs the field parties as to the number of cans allotted to each block. The field parties work one section of a city at a time in parallel blocks. This saves time and makes it easy for the man in the car to locate the field parties .

Through the courtesy of the U. S. Bureau of Entomology, Mr. E. R. Barber kindly took charge of the first campaigns put on in Mississippi. During the Fall of 1920 (under Mr. Barber's direction) Woodville, Durant, Crystal Springs and Laurel put on successful campaigns against the Argentine Ant. Each of these towns wished to repeat the work during 1921, while Columbus, Aberdeen, Gulfport, and Hazlehurst have also put on campaigns this fall. Many other towns have the subject under consideration. In every case the city authorities and the people generally are delighted with the results. This year Mr. Barber could not assist us directly, but instead of preparing the poisoned syrup at each town, we bought it in large quantities in New Orleans where it had been prepared under Mr. Barber's supervision. This year the city of New Orleans is making a determined fight against this insect and under Mr. Barber's direction is putting out 300,000 cans of poisoned syrup. Reports have reached us that various other towns in Alabama, Louisiana and Texas have been following the same method of fighting the ant.

We feel that the Argentine ant has not received the attention that it deserves. It is a pest of National importance, and should not be considered as a local problem. It is now established in many towns in at least ten states. We hope that it will soon receive attention from the Federal authorities similar to that now being given the European Corn Borer, Green Japanese Beetle, Pink Bollworm and Gipsy Moth, with which it ranks in importance as a pest. It is almost certain that the further spread of this ant could be greatly checked. It could be brought under almost complete control in many of the infested areas at a cost far below what it costs to leave it uncontrolled, and it would pay to completely eradicate it from certain areas. Our experience indicates that this is entirely possible.

MR. E. O. G. KELLY: I would like to ask Mr. Harned what size the can is?

MR. R. W. HARNED: The size of an ordinary tumbler. It can be secured from the American Can Company of New Orleans.

PRESIDENT GEORGE A. DEAN: The next paper is illustrated by moving pictures.

IMPORTANT BIOLOGICAL FACTS ON THE OX-WARBLE CONTROL

By F. C. BISHOP, E. W. LAAKE and R. W. WELLS

(Withdrawn for publication elsewhere)

MR. R. C. TREHERNE: Does that apply for both species?

MR. F. C. BISHOPP: Yes, the film was designed to cover both.

MR. L. CAESAR: Would four treatments be sufficient, do you suppose?

MR. F. C. BISHOPP: I would say that would be ample. We give those at intervals of about thirty days. In that way we catch all of the grubs that come up from the internal anatomy of the animal and develop on the back.

MR. E. G. KELLY: Could you tell us some remedy other than just squeezing the grubs out?

MR. F. C. BISHOPP: There was a part of this film relating to the application of iodoform-vaseline to the grub holes, which was eliminated. We have found that a considerable percentage of the grubs killed by this ointment will emerge from the animal and others will be absorbed, but without harm.

MR. E. G. KELLY: What percentage of the grubs that you squeeze out of the hides mature as adults?

MR. F. C. BISHOPP: That depends on the stage of development. We find it is necessary for the grubs to be almost ready to emerge normally in order to transform. Ordinarily it is not necessary to destroy any of those squeezed out, with the exception of those which have taken on the brown or black color, which is indicative of the time being ripe for them to drop out.

MR. R. C. TREHERNE: Do either of these species occur on horses?

MR. F. C. BISHOPP: We have found Hypoderma larvae to a certain extent in the backs of horses. We consider the horse of little importance in connection with possible eradicative or control work. It is an abnormal host. That is also true of a good many other animals.

Mr. E. G. KELLY: How do you mix the treatment?

MR. F. C. BISHOPP: One part of iodoform to five of vaseline. As I mentioned in another paper, we have found certain washes are effective and we have hopes of developing them. Derris in soapy water has been found to kill almost one hundred per cent. with a single application, applied with a brush to the backs of the animals. I might say also that the British Board of Agriculture is advocating the use of a tobacco decoction on the backs of cattle.

MR. C. E. PETCH: Have you noticed any effect that wet springs have on the prevalence of the grubs?

MR. F. C. BISHOPP: Wet springs are always unfavorable to them. That comes about in two ways, we think, first, due to the ill effect on the pupae, and the second due to the effect on the flies when they want to deposit their eggs. Most egg laying occurs in the sunshine and if you have continued cool cloudy weather it results in the destruction of the adults before they have a chance to deposit. Nearly always the next year following a rainy, cool spring, you find a lower percentage of infestation.

PRESIDENT GEORGE A. DEAN: The next paper is by N. F. Howard.

THE MEXICAN BEAN BEETLE IN THE SOUTHEASTERN U. S.

By NEALE F. HOWARD, *Specialist in charge, Research Work on Mexican Bean Beetle, Bureau of Entomology*[1] *in cooperation with the Alabama Experiment Station, Alabama Polytechnic Institute.*

The Mexican bean beetle (*Epilachna corrupta* Muls.) is rapidly assuming a prominent place among the foremost injurious insects of the United States. It has demontrated its importance not only in actual

[1]Progress report prepared December 15, 1921 at Birmingham, Ala., with the assistance of Messrs. L. L. English, J. R. Douglass and others, Bureau of Entomology. Some data published in the Quarterly Bulletin of the State Plant Board of Florida, October, 1921, pp. 15—24, are not included.

money damage, but also in its capacity for destruction wherever it has become established, and in its tremendous capability for rapid spread. In the Birmingham district of northern Alabama early in the summer of 1921, the bean crop was destroyed in almost every case. When garden bean foliage became scarce, serious damage was sometimes done to cowpeas, and soy beans were occasionally injured. A number of new cultivated and wild food plants have been discovered, and the species is now permanently established in the Southeast. Since it thrives on the important forage and cover crops, cowpeas and soy beans, its potential importance to the general farmer is immense.

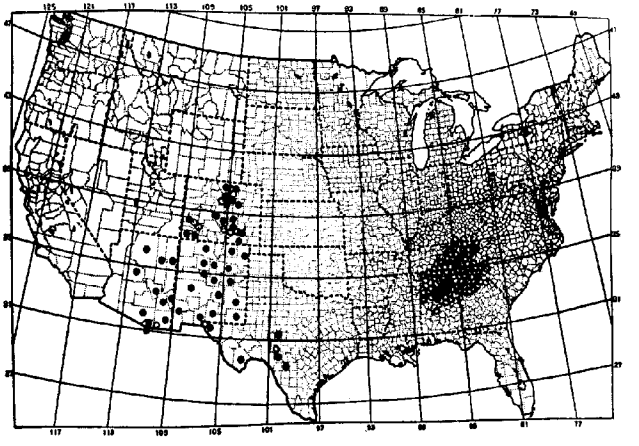


Fig. 8.—Map showing distribution of Mexican Bean Beetle to Dec. 31, 1921.

Distribution in 1921

The accompanying map (Fig. 8), prepared under the direction of Dr. F. H. Chittenden and Mr. J. E. Graf, shows the present known distribution of the Mexican bean beetle in the United States. The trend of distribution in the Southeastern United States is northward and, with the exception of the Thomasville, Ga., infestation, follows the mountainous or hilly country. This latter infestation is heavy over a small area and is important in that it indicates the ability of the species to thrive in flat country under extreme southern conditions. The insect has demonstrated its resistance to lower extremes of temperature and high altitudes in the West, and it will flourish also in the Northern and

Eastern United States, when it reaches these sections, as it undoubtedly will in course of time.

Life History Notes

Emergence from hibernation was first observed March 22, 1921, when adults and eggs were taken in the field. A series of frosts a week later destroyed all bean plants and eggs but did not affect the adults. Table I, the data of which were taken from 209 experiments, gives an idea of the life history as investigated the past season 610 feet above sea level.

Table I.—Life-History Data on The Mexican Bean Beetle in the Southeastern United States

Experiment No.	Date eggs deposited	Incubation period	First instar	Second instar	Third instar	Fourth instar	Pupation period.	Date of emergence	Developmental period	Mean temp.
			Days	Days	Days	Days	Days		Days	°F
LH 1.....	Mar. 22	15	8	7	7	12	9	May 19	58	64.9
LH4 3G..	June 7	5	4	4	3	5	6	July 4	27	82.7
LH1 1G2..	July 11	5	3	3	3	6	5	Aug. 5	25	84.6
LH5 2G2	Aug. 23	7	3	3	3	6	5	Sep. 19	27	81.1
LH6 3G3	Sep. 16	6	4	3	4	16	13	Nov. 1	46	68.6

Four generations from first egg to first adult were completed in the insectary near Birmingham, Ala., and the temperature would have permitted another generation to develop, at least partially, but this did not occur. A period of from 6 to 10 days, averaging 7 days, elapsed during July and August between the emergence of the female from the pupa and egg deposition.

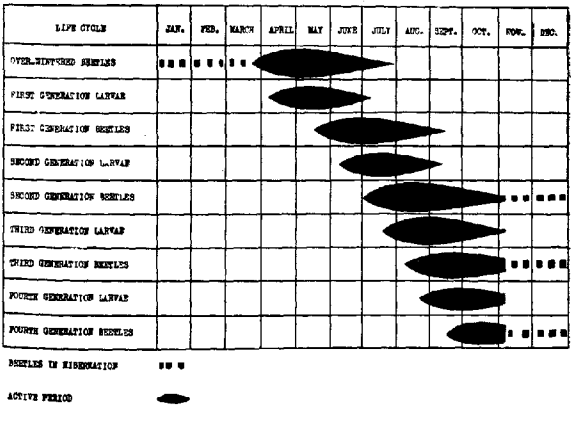


Fig. 9.—Seasonal history of Mexican Bean Beetle, Birmingham, Ala., 1921

Successful development has not been observed at a temperature below 60° F. Eggs withstood 31° F., March 29. The highest daily mean temperature during summer (U. S. Weather Bureau Record) was 88° F., August 1.

The number of eggs in a mass ranges from 5 to 76, with an average of 52.7 eggs in a group, calculated from 207 groups. The largest number of egg masses laid by a single female was 34 comprising 1,669 eggs. Of 1,691 beetles, 51.45 per cent. were males and 48.55 percent were females.

Fertile eggs were obtained from females collected in hibernation and isolated, showing that fertilization in the spring is not necessary.

DISPERSION

Flight is the most important means of natural dispersion. Marked beetles have been taken 5 miles from the point of liberation in one instance and 3½ miles in two instances, as table 2 shows.

TABLE 2.—RECORDS OF FLIGHT OF MEXICAN BEAN BEETLES

[1]Date liberated	Number of marked beetles liberated	[2]Collections of marked beetles		
		Date collected	Distance from point of liberation (by shortest air route).	Number of marked beetles collected.
1921		1921	MILES	
Aug 4.....	550	Aug. 8	3.5	1
		Aug. 18	0.25	[3]5
Aug. 17.....	5,000	Aug. 19	5.	3
		Aug. 20	2.2	[4]1
		Aug. 24	3.5	2

[1]Liberation was made at 720 feet above sea level.
[2]In two instances, collections were made in opposite directions.
[3]Others observed but not collected.
[4]Crossed hills 800 to 1,150 feet above sea level.

INSECT ENEMIES AND NATURAL CONTROL

In addition to the list of species already published, the following have since been determined from field observations as enemies of *Epilachna corrupta*: The lepidopterous larvae, *Prodenia ornithogalli* Guen., *Laphygma frugiperda* S. & A. and *Heliothis obsoleta* Fab., and the diadem assassin bug (*Sinea diadema* Fab.). These species were fed a restricted diet of bean beetle larvae and pupae in confinement, and two species matured. In the insectary and some of the field cages the ants, *Solenopsis geminata* Fab. and *Pheidole* sp., destroyed pupae.

None of these species is of much value in natural control.

HIBERNATION

Hibernation is the most pronounced characteristic of the family Coccinellidae which the Mexican bean beetle retains. The beetle hibernates gregariously, as well as singly, but not in as large groups or as compactly as *Megilla maculata* DeG., and many other coccinellid species in California. Many individuals occur singly, and colonies are not compact. At this writing, December 15, the beetles are still congregating, as determined by marking beetles in colonies with different colored waterproof marks, and observing them at intervals. Table 3 gives a brief summary of the data on hibernation.

TABLE 3.—DATA ON HIBERNATION OF THE MEXICAN BEAN BEETLE.

Total number of searches	Searches with positive results	Searches with negative results	Total number of beetles found	Number of beetles found singly or in small groups	Number of beetles found in groups of 25 or more in 200 sq. ft. or less	Number of colonies with 25 beetles or more in 200 sq. ft. or less
303	104	199	2,198	977	1,221	12

COLONIES OF MARKED BEETLES

Colony No.	Original number of beetles in colony when marked	Date marked	Observations on marked beetles					
			Date	Number of new beetles	Number of painted beetles	Date	Number of new beetles	Number of painted beetles
		1921	1921					
1 Red	149	Nov. 22	Dec 9	47				
2 Black	299	Nov. 18	"	103		[1]Dec. 15	168	161
3 Purple	80	Dec. 10	Dec. 15	8	68			
4 White	65	"	"	12	43			
5 Green	72	Dec. 13	"	0	70			
6 Red	103	"	"	0	96			

[1]Destroyed by intruders.

It will be noted that beetles are not only joining these colonies, but some of the original beetles are leaving, and that the insect is not completely dormant during the winter in northern Alabama.

Field observations on an isolated farm proved that the spring migration from hibernation lasted at least as late as the middle of May. March was exceptionally warm, averaging 7.7° F. daily excess above normal. Field observations indicated that the peak of emergence was late in April and early in May.

The preferred winter quarters, so far as observed, are wooded slopes, especially pine and oak growths. Well protected spaces, where branches, tree trunks, or other obstructions have caused accumulations of leaves or pine needles, are chosen. The beetles occur in this material at a depth of an inch or more, seldom resting on the ground, and as yet have not been found hibernating in the soil. The beetles ordinarily

have been observed under good drainage conditions, but usually considerable moisture is present. As hibernating material dries out, the beetles seek a moist location and go deeper under the leaves. On warm days they become active.

A few beetles have been found hibernating 1 mile from the nearest bean field, 25 individuals three-fourths of a mile from the nearest field, and large numbers one-fourth and three-eights of a mile from the nearest fields. The majority of those observed, however, were within one-fourth of a mile of bean fields which had been destroyed.[1]

From information gained in 1921, it is evident that a "clean-up" practice which merely includes the garden patch or small farm is not likely to be of great value. A few beetles always occur in gardens and bean fields, but may be considered stragglers.

Table 4 gives the length of life of the adults, by generations, obtained from first eggs of first pairs in each case, which were checked with field cages, from insectary records.

This species may be considered a double-generation insect in the Southeastern United States, while it is a single-generation insect in the Western and Southwestern United States, and probably in many parts of old Mexico. In Alabama it could undoubtedly survive, however, with one generation under certain conditions. Owing to a retarded issuance from hibernation of a certain percentage and because of the longevity of the beetles, there is an overlapping of generations, which

TABLE 4.—LENGTH OF LIFE OF ADULTS OF THE MEXICAN BEAN BEETLE

Generation	Number of beetles	Developed		Date of death of majority beetles	Date of death last beetle	Beetles entering hibernation	Approximate length of life
		From —	To —				
		1921	1921	1921	1921	PER CENT	MONTHS
Overwintering (1920–1921)	397			late May	July 27		7–8
First	339	May 18	July 11	middle of July	Sep. 13		2
Second	540	July 1	Sep. 15	last half of August	.....	5.37	(1)
Third	542	Aug. 5	Nov. 4	early half of October	.....	55.17	(1)
Fourth	274	Sep. 13	Nov. 4	late October	.....	90.88	(1)

[1]Still living, November 4.

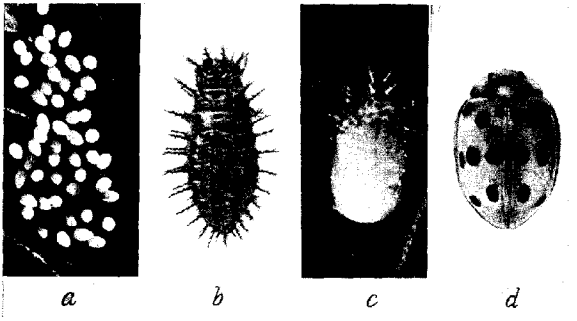
[1]Early in April, 1922, Mr. J. E. Graf, Bureau of Entomology, accompanied by Mr. J. G. Hamilton of Torrance County, New Mexico, found the Mexican bean beetle hibernating 17 miles west of Estanica in loose colonies in piles of oak leaves and pine needles, 7½ miles from any bean fields. Beetles in trash near bean fields were extremely rare.

PLATE 4

Mexican Bean Beetle: Upper figure, beetles hibernating in pine needles, oak and other leaves.

Lower figure, hibernation quarters under pine brush (Original, N. F. Howard).

PLATE 5



Mexican Bean Beetle: Upper figure, *a*, egg group; *b*, larva; *c*, pupa; *d*, adult beetle, all highly magnified.
Lower figure, total destruction to pole lima beans (Original, N. F. Howard).

resulted the past season in the occurrence of the peak of infestation in late July and early August. In the late summer and early fall the beetles became extremely active. One field of beans was carefully picked free of adults almost daily in October, and during 24 hours adults flew in from other fields which had been destroyed.

Artificial Control

The Mexican bean beetle feeds in both larva and adult stages on the underside of the leaves of bean and other food plants. The larva consumes relatively greater quantities of leaf tissue and consequently is the more destructive stage. Since the larva does not leave the plant under normal conditions, because of its great susceptibility to direct sunlight, which causes it to succumb in a few minutes where shade temperatures are over 90° F., the proper distribution of a stomach poison to the underside of the leaves is essential.

The susceptibility of bean foliage to injury from arsenical treatment is well known and the practical application of arsenicals must be made with this in mind. Injury to bean foliage is probably a complex result of at least several contributing factors. The season's observations indicate: (1) That the water-soluble arsenic content of an arsenical is an important factor; (2) that the stability of the arsenical is probably a factor; (3) that the soluble mineral content of water used when wet sprays are applied is an important factor[2]; (4) that there are seasonal variations in the susceptibility of bean plants to injury; and (5) that the vigor of the plants appears to be a factor. Plants withstood spray applications better in early spring and late fall than during the heat of the summer, even when applications were made with arsenicals and water from the same source. Wet sprays were almost consistently more injurious than dusts, even though the application of the latter as practiced in the experiments distributed more of the arsenicals per acre.

Where wet sprays were used without serious injury to the foliage, better insect control was obtained than with dusting and this was undoubtedly due to the more effective distribution of the arsenical to the lower surface of the leaves, and the better adhesion of the particles.

Arsenical Sprays

The commercially available arsenicals tested, viz., calcium arsenate, zinc arsenite, lead arsenate, and Paris green, used as wet sprays, caused

[2]Valuable assistance was received in this phase of the work from Dr. Wm. Moore and Mr. C. M. Smith of the U. S. Bureau of Entomology.

injury in too many cases to make their recommendation general. Magnesium arsenate, formerly a commercial product, was injurious to a marked degree in only 2 out of 31 treatments; but since this arsenical is not now available, and in view of the fact that it has been tested during only one season, it cannot be generally recommended. As formerly prepared, it is unsuitable for dusting.

With present knowledge, wet sprays cannot be generally recommended, and growers are advised to try them out under local conditions, using the purest water available, preferably rain water collected from buildings. Zinc arsenite is the safest commercially available arsenical tested. It will effect efficient control if applied at the rate of three-fourths of a pound to 50 gallons of water, or at the rate of one ounce to four gallons. It should be applied to the underside of the leaves, at a high pressure, with a nozzle set at right angles to the discharge tube. The mixture must be continually agitated. An acre of bush beans in full leaf requires from 50 to 75 gallons of liquid, the rows being sprayed from each side with a small sprayer.

Paris green, as is well known, cannot be applied to beans because of the certain burning of the foliage.

Dusts

Successful dusting of garden beans for the control of the Mexican bean beetle requires the application of the poison to the underside of the leaves. This can be done best on a small scale with available machinery by means of a bellows type of duster provided with a long spout on a flexible hose, which makes it possible to direct the dust to the underside of the leaves and to distribute it among the clusters of hanging leaves. Care must be exercised to avoid distributing too much dust per acre, and in heavy puffs at the stroke of the bellows.

Cloud dusting in the early morning with various types of hand machines was not thoroughly successful on bush beans, the force of the air blast when directed against the ground being insufficient to carry the dust thoroughly to the underside of the leaves. On large acreages better results may be obtainable by the use of power machines.

Arsenical dusts gave control in direct proportion to the percentage of arsenical in the dust. No appreciable foliage injury was obtained from any of the arsenicals used when these were diluted 9 times with hydrated lime, but control was far from perfect. Applications must be made every 5 or 6 days, where infestation is heavy, and must be started as soon as the beans put out true leaves.

Calcium arsenate is the best arsenical available to southern growers for dusting purposes, but it will cause defoliation of beans in most cases

unless diluted, and only the best grades must be used.

Nicotine dusts, contining from 1 to 10 per cent of nicotine sulphate, by weight, gave no control.

Pyrethrum, or insect powder, is a powerful contact insecticide, especially against the adult bean beetle. A good grade may be diluted as much as one-half with cornstarch or hydrated lime. It is not so effective against the larva, and does not affect eggs or pupae under field conditions. The cost and scarcity, as well as the impracticability of a contact insecticide against an insect of this nature, prohibit its general use either for farm or garden.

Derris, while superior to pyrethrum powder, falls in the same category.

Use of Sprayed Beans as Food

Chemical analyses of beans which had been wet-sprayed by a grower 7 days previous to picking prove that little danger of arsenical poisoning results from the application of arsenicals in the relative proportions of 2 pounds of lead arsenate to 50 gallons of water. From a quart of green beans picked June 3 from a field which had been sprayed thoroughly May 27, less than one-fiftieth of what is ordinarily considered a lethal dose of arsenic was present in very careful washings, and one-hundredth of a lethal dose was left on the beans. Nine other samples from experimental plots treated with various arsenicals as dusts and sprays showed less than 10 milligrams of arsenic expressed as As_2O_5 in very careful washings from a quart of green beans, picked 21 days after the last arsenical treatment. All visible traces of insecticides should be washed from green beans, however, before cooking.

Cultural Practices and Crop Substitutes

All stages of the beetle are destroyed by covering them with one inch or more of clay soil during the summer. In cases of heavy infestation, fields should be plowed under.

About Birmingham, Ala. in 1921, early planting was impracticable because the beetles were afield before the last frosts. Very early plantings of bush snap beans, however, produced a crop in locations where infestation was not so heavy.

The discovery of a number of wild host plants[4] in addition to those already recorded, and in addition to the cultivated hosts already recorded, indicates the futility of attempting to eradicate this species by discontinuing the planting of garden beans.

[3]Analyses by Mr. R. W. Allen, field assistant.

[4]*Meiboma tortuosa, M. canescens, M. viridiflora, Galactia volubilis, Lespedeza virginica.*

The growing of beans during alternate years may prove worthy of trial, but it would necessitate close community effort in areas at least the size of a large county, because of the prolonged flights of which the beetle is capable.

The use of the Windsor or broad beans (*Vicia faba*) as a substitute for garden beans for human consumption will only partially alleviate the situation, provided the crop meets with public approval, because in the South this crop can not be grown successfully during the summer. It is an excellent early-spring crop, however, under southern conditions, and the young, green seed, properly cooked, is relished by those who know it.

The use of substitute crops, since the soy bean and cowpea as forage and cover crops are threatened, may prove promising. The mung bean (*Phaseolus aureus*) has thus far proved absolutely resistant to beetle attack, and a bush variety of the immune velvet bean might fit into farm rotation in many cases. The adsuki bean, while slightly susceptible, is not favored by the beetle, and this crop also may be of value as a substitute.

Necessity for Thorough Study

A world-wide search for effective natural enemies, insect, bacterial, and fungus, is imperative before the bean beetle becomes more widely distributed. Adaptation of one of the known stomach poisons so that it may be applied with safety to the foliage of beans, involving determination of the causes of arsenical injury to foliage, is worthy of intensive study. Search for new stomach poisons should be constantly made. The perfection of machinery for the application of dusts to the underside of bean leaves is also important, and the solution of this last problem is essential to the successful adaptation of dusting to the control of other truck-crop insects.

Mr. G. E. Sanders: Is copper in small quantities, such as a mixture of a small quantity of Bordeaux dust, used in combination with arsenicals as a preventing agent?

Mr. N. F. Howard: We used a dust (our No. 23) comprising 10% commercial Bordeaux powder of 22% metallic copper content; 10% commercial arsenate of lead; and 80% hydrated lime. This dust did not injure bean foliage in any of nine applications, but a ten per cent. arsenate of lead-hydrated lime dust did not injure the foliage either. Copper in Bordeaux as a wet spray seemed to increase injury.

Mr. G. E. Sanders: You are sure it wasn't copper injury to the bean plants direct, instead of arsenical injury?

MR. N. F. HOWARD: No sir.

MR. G. E. SANDERS: There is an interesting point there. Magnesium arsenate proved quite a bit safer than calcium. I would like to hear the chemical reason for that from Professor Moore.

MR. WILLIAM MOORE: The conditions in the South, south of the James River, in geological surveys show that the natural water contains an excess of strong bases over strong acids, producing an alkaline water, due to sodium carbonate. Most if not all alkaline materials which give an alkaline reaction with phenolphthalein will react with acid lead arsenate.

It is of interest that although entomologists have been using lime for twenty years with lead arsenate to reduce the amount of soluble arsenate, the reaction of the lime actually increases the amount of soluble arsenate when mixed with acid lead arsenate. Concerning magnesium arsenate I believe there has been some objection by the Insecticide Board because of its injury. Mr. Howard reports from the South that magnesium arsenate gave less injury than with calcium arsenate. In the case of magnesium arsenate, the compound itself is somewhat more soluble than calcium arsenate. If there were no further decompositions more injury would be obtained with magnesium arsenate than with calcium arsenate but when the climate is such as to favor the action of carbon dioxide on the calcium arsenate, you get a decomposition of the calcium arsenate and it then becomes more injurious than the magnesium arsenate.

PRESIDENT GEORGE A. DEAN: We will now listen to Mr. W. E. Britton.

TOBACCO PLANT INJURED BY THE SEED CORN MAGGOT

By W. E. BRITTON,

State Entomologist, New Haven, Conn.

On the plantation of the Windsor Tobacco Grower's Corporation at Windsor, Conn., a large acreage of tobacco is grown under cloth for cigar wrappers. In one field of forty acres, one half, or twenty acres, soon after setting, had the plants injured by maggots which tunneled into the sides of the stems just below the surface of the ground. In some cases the injury was very slight and inconspicuous and showed only as a small pin-hole in the side of the stem, but in other cases the tunnel was considerably enlarged inside the stem and extended upward or downward in the pith for half an inch or more. A slight decay had started around the injury in some plants. The manager examined and

counted 100 plants, and found that between 80 and 90 of them were infested.

I visited the field by his request on May 26, 1921, perhaps two weeks after setting. At that time nearly all of the maggots had left the plants and most of them had pupated in the soil close to the stems of the plants. It seemed to me that most of these plants would recover, but the manager stated that any injury to the pith is sufficiently serious so that the plant will never develop a good crop of wrapper leaf tobacco. This opinion seems to be shared by experienced tobacco growers generally.

Material was gathered and placed in breeding cages in the insectary and on May 31 and following, several adult flies emerged. Specimens were sent to the Bureau of Entomology at Washington, and the species was identified as *Hylemyia cilicrura* Rond., otherwise known as *Phorbia* (or *Pegomyia*) *fusciceps* Zett., commonly called the "seed corn maggot," and the "bean maggot." This insect is closely allied to the onion maggot, *Hylemyia antiqua* Schiner, the cabbage maggot, *Chortophila* (*Phorbia*) *brassicae* Bouché, and the spinach leafminer, *Pegomyia hyoscyami* Panz. Though this insect has an extensive literature and is known to attack a great number of vegetable and field crops, I have not been able to find tobacco mentioned as a food plant. Now the insect is guilty on another count.

The tobacco was grown on a light sandy soil, and the manager informed me that this particular section of twenty acres was covered with clover the preceding season and was plowed under last spring. The ground was harrowed and reset, and no further trouble developed. The injury was not found on any other ground except on this section where clover sod was plowed under.

MR. W. P. FLINT: It might be interesting to know that we had two cases in Illinois this year where newly set strawberry plants were injured in the same way by the corn seed maggot. In one rather large field, about two and one-half acres in all, there were spots over the whole field where plants were destroyed.

PRESIDENT GEORGE A. DEAN: The next paper is by Z. P. Metcalf.

THE TRAP BED METHOD FOR THE CONTROL OF THE TOBACCO FLEA BEETLE

By Z. P. METCALF, *Raleigh, N. C.*

(Withdrawn for publication elsewhere)

MR. E. G. KELLY: I would like to ask at what time the farmers spread the canvas over the beds.

MR. Z. P. METCALF: In North Carolina the custom is to put the canvas over the bed a short time after the seed is sown.

MR. W. E. BRITTON: I would like to ask about dipping the plants at the time of seeding?

MR. Z. P. METCALF: We have secured excellent results from dipping the plants at the time of seeding. I think that is a necessary part of the program as far as North Carolina is concerned.

Adjournment.

INSECT PROBLEMS IN INDIANA DURING 1921

(Condensed)

By JOHN J. DAVIS, *West LaFayette, Indiana*

The past season has been one of unusual insect activity in Indiana, as in other sections of the United States, due apparently to a combination of causes, important of which were the mild winter of 1920-21 and the unusual seasonal weather conditions the past summer. On the other hand, the scarcity and almost total absence of grasshoppers in destructive numbers throughout the state was very noticeable. The weather conditions favoring insects were the high temperatures which ranged from 2° to 10° F. above normal through the season, excepting for a short period the latter part of July, the excessive rainfall which averaged nearly two inches above normal, excepting a period during midsummer, and the long developmental season which began early in March and continued late. In other words Indiana moved two to three hundred miles south so far as weather conditions were concerned and insects had ideal conditions to increase and develop.

The first crop pest of importance to be noticed was the clover leaf weevil (*Phytonomus punctatus*), which occurred in destructive abundance throughout the southern half to two-thirds of the state. The first reports were received from the extreme southern end March 21 and frequent reports were received from that date until the end of April. In some sections large acreages of both red and mammoth clover were killed by this insect.

Hardly had the leaf-weevil outbreak subsided until we began to receive reports of serious damage to red and English clover by the so-called lesser clover-leaf weevil but which we prefer, because of its importance and feeding habits, to call the clover-bud worm (*Phytonomus nigrirostris*). Reports of injury were most numerous from May 17 to June 16 and were confined largely to central Indiana. The clover-bud worm is a pest of comparatively recent prominence in Indiana but

for the past five or six years it has been gradually increasing in abundance, particularly in central Indiana, until it has become a clover pest of prime importance. Apparently it is not an insect which occurs periodically but rather is one to be expected as an annual pest and its range of destruction is being gradually extended each year. The insect seems to prefer red and English clover and the injury caused by the larvae is to the developing buds, these being killed by the larvae which feed on the buds beneath the basal leaf sheaths.

The striped cucumber beetle (*Diabrotica vittata*) is an annual pest of considerable importance to cucumber and melon, which are extensively grown and valuable crops in Indiana. The calcium arsenate and gypsum (1 to 20) remedy suggested by Prof. H. A. Gossard was extensively used in some sections of the state, and in all cases which have come to our attention it proved thoroughly satisfactory. As an example, on May 10 the beetles made their conspicuous appearance at LaFayette, coming in swarms, apparently with an easterly wind, from the bottom lands of the Wabash river, nearly a mile away. They attacked the cucumbers in frames, by the thousands. Within a day after their appearance the plants were dusted with the calcium arsenate-gypsum mixture with very evident positive results, the beetles being found dead on the soil a day later and very few live ones left to molest the plants. The cucumber beetle is most serious in Indiana during the months of May and June and reports were received mostly during June.

Aphids were abundant in some sections of the state, the most prominent of which were the black peach aphis (*Anuraphis persicaeniger*), the melon aphis (*Aphis gossypii*) which appeared late but was very destructive nevertheless, and the gooseberry aphis (*Aphis houghtonensis*).

Flea beetles of various species, including the black flea beetle and the striped species, were unusually abundant in Indiana the past season, particularly in the western half and southern two-thirds of the state. Corn and potatoes were the usual crops attacked and the first reports were received about May 20, and numbers of reports continued to come to our attention until early in June.

The cabbage root maggot (*Phorbia brassicae*) which is particularly destructive to early cabbage, cauliflower and radish in the northern part of the state, is without question the most important pest of these crops in Indiana. Experiments were conducted at Fort Wayne and near Hammond, Indiana, and the practicableness and effectiveness of corrosive sublimate treatments, both as a dust and as a liquid, were thoroughly demonstrated. The results of these experiments are given in Leaflet 123 of the Purdue University Agricultural Extension Department.

Shade tree insects were prominent the past year, particularly the cottony maple scale (*Pulvinaria vitis*) and oyster shell scale (*Lepidosaphes ulmi*). Both insects were unusually prevalent in the northern half of the state. Reports of the cottony maple scale began to come in the latter part of May and continued throughout the month of June. Hardly a town in the northern half of the state but what reported trouble from this insect. Less evident, but in some cases just as serious was the oyster shell scale. By June 3 the over-wintering eggs had begun to hatch in all parts of northern Indiana and in general, they all hatched out in a comparatively short time. On June 15, some days after all of the eggs had hatched, and after they had formed a considerable scale, we sprayed a lilac hedge, at LaFayette, Indiana, with two mixtures: one, nicotine oleate at the rate of one ounce to a gallon, and the other fish-oil soap and nicotine extract at the rate of one pound soap to five gallons of water, to which was added one ounce of nicotine sulphate. Counts from different sections of the hedge gave us 84 per cent. mortality in case of those sprayed with the soap and nicotine sulphate, and 80 percent mortality in case of those sprayed with nicotine oleate. In general, our observations indicate that fish-oil soap is preferable to nicotine oleate for the control of immature scale insects such as oyster shell scale, cottony maple scale, and San Jose scale.

Rose beetles (*Macrodactylus subspinosus*) were more abundant in Indiana than usual, injury being reported from points in the extreme southern and in the extreme northern end of Indiana, the first reports being received May 26 and the last June 16. Inquiries referred to the rose beetle as damaging peach, grapes, corn, and rose, and in one instance, we had a report of the poisoning of poultry from eating rose beetles.

The latter part of June we began to receive reports of chinch bug abundance. Previous surveys and observations indicated that the chinch bug would be abundant in many sections of the state. Following these indications, chinch bugs were more abundant and more destructive than they had been for many years. Fortunately, however, rainy weather during the hatching of the eggs of the second brood prevented more widespread injury which otherwise would undoubtedly have resulted. Our experiments demonstrated the value of the creosote barrier band as recommended by Flint of Illinois, and they also showed that infestations could be controlled after the bugs entered the corn field, but before they scattered, by the use of fish-oil soap sprays and nicotine sulphate with soap. Although the late summer weather conditions did materially reduce the numbers of the bugs many went into hibernation successfully and there is every reason to believe that the infestation

next year will be equal or greater and more widespread than the present year unless weather or other natural conditions prevent.

Blister beetles (*Epicauta vittata*, *E. cinerea*, *E. marginata*, *E. pennsylvanica*, and *Macrobasis unicolor*) were more abundant than usual, attacking potatoes, tomatoes, and other garden crops. This appears to be a logical sequence following grasshopper outbreaks of recent years.

White grubs (*Lachnosterna* spp.) were also more abundant than usual and the reports of injury were received from many sections of the state. Reports were received during the months of July, August, and September, and the crops most commonly injured were corn and strawberries.

During the latter part of September we began to receive reports of various insects attacking alfalfa and in a few cases clover also. The first of these, the alfalfa web-worm, (*Loxostege similalis*) was found to be damaging alfalfa in many sections of the extreme northern and northwestern sections of the state, the latter third of September. Almost simultaneously reports and specimens of the fall army worm (*Laphygma frugiperda*) were received from the same section of the state. The crops injured in this case were alfalfa and clover. A third lepidopterous larva was repeatedly reported from the northern half of the state, the last of September and during October. This insect resembles the corn earworm in many respects but there seems to be certain consistent differences which may or may not be specific. Adults have not yet been reared.

The corn earworm (*Chloridea obsoleta*) was unusually abundant the latter part of September and during October. It was prevalent throughout the state, both field and sweet corn as well as many other plants being injured. There has been much fear manifested by farmers throughout the state as to possible harm to cattle feeding on earworm-infested corn. Observations to date indicate that corn earworm injury and the usual moulds following such injury are not harmful to farm animals but that certain other moulds which were prevalent the past season, but which do not follow corn earworm injury, may under certain conditions be harmful to animals.

Another insect which was unusually abundant the latter part of September and the first of October was the cotton caterpillar (*Alabama argillacea*). These moths appeared in isolated sections of the state and were reported as damaging various crops such as apple, but particularly were they destructive to ever-bearing strawberries in the northern part of the state.

Insects such as the peach tree borer, codling moth, fruit tree bark

beetle or shot-hole borer, Hessian fly and San Jose scale were reported to us throughout the season.

The peach tree borer (*Sanninoidea exitiosa*) has been the subject of repeated inquiries which resulted from publicity given the new PDB (ParaDichloroBenzene—Positive Death to Borers) treatment. Our experiments the past spring made in various sections of the state from the extreme southern to the extreme northern end show that spring applications (made during the month of May) are thoroughly effective against the peach tree borer and may be used to advantage where the fall applications have been neglected. We also found that the sublimed or flaky form and granular were equally effective as was also the crude granular. The latter was furnished us by the International Chemical Company of Cleveland, Ohio. If regularly available, it can be purchased at a much less price than the pure form and gives just as good results. It was also determined after a number of tests that treatment on sod ground was just as effective as where the ground was cultivated.

The Hessian fly (*Phytophaga destructor*) appeared in appreciable numbers last spring, the first eggs being observed at LaFayette April 4. Although there was an appreciable infestation, it did not show up conspicuously by fallen straws as is usual with these spring infestations. Instead the spring brood of larvae killed the shoots while they were small, the injury more nearly resembling the fall injury by the fly. Heavy parasitism undoubtedly reduced the numbers for the fall generation appreciably but throughout the state wherever wheat was sown earlier than a week before the recommended fly-free date, heavy infestation resulted. Fortunately, sowing wheat after the fly-free date in Indiana was almost universal, and with good results.

The San Jose scale (*Aspidiotus perniciosus*) is apparently increasing in abundance in Indiana, necessitating further studies, particularly with reference to the efficiency of the dry lime-sulphurs. The causes for the increase are apparently due first of all to improper applications and lack of thoroughness. Whether or not the spray gun has had its influence in this connection is a question which cannot be answered with certainty at the present time but there is a tendency to do less thorough work with the gun than with the rod. Other contributory causes are probably, improper dilutions, time of applications, variable insecticides on the market, and effect of parasites and predatory enemies.

Tests were made the past spring in two localities in southern Indiana to determine the relative efficiency of different dormant sprays now on the market. Applications were made to apple late in the spring when the buds showed pink, practically a delayed dormant spray. A stand-

ard miscible oil and liquid-concentrate lime-sulphur were used in comparison with several brands of dry lime-sulphurs, and at least four trees were treated with each material. The regular summer sprays were applied by the orchardists, all trees receiving the same treatment after the dormant spray. While it is not desirable to make definite recommendations or draw definite conclusions from the results of a single season's observations, the results show a general tendency which are interesting. Counts were made a month after the treatment to determine the percent of live scale; three months after the applications to determine the approximate infestation on the new twigs, and in the fall to obtain the leaf infestation. The first count was a careful examination of 250 scales to get the percent of scales alive. The second count was an estimate of the infestation of the new twigs. The third count was an actual count of the scales on 100 leaves collected from different trees. Miscible oil, 1 to 15, and liquid-concentrate lime-sulphur, 1 to 7½, gave very good control. None of the dry lime-sulphurs, soluble sulphurs, or barium tetrasulphide, gave results comparable with the liquid concentrate, when used at label strength. Some gave fair results at (1½) label strength and most gave good results, equal to the liquid concentrate, when used at twice label strength. It might be added that the dry lime-sulphurs did give appreciable controls over the untreated.

From these results we do not feel justified in recommending dry lime-sulphur, but if the liquid or miscible oil are not available, dry lime-sulphur should be used at 1½ to 2 times label strength.

The experiments are being continued, and in addition, tests are being made to determine the value of fall versus spring applications, and the relation of spraying to parasitism, etc.

THE MAPLE CASE-BEARER *PARACLEMENSIA ACERIFOLIELLA* FITCH.

By GLENN W. HERRICK

Although the census of 1920 indicates that, on the whole, the volume of the maple sugar industry of New York State has decreased during the last twenty years yet the total value of the maple sugar and syrup manufactured during 1919 was $3,399,434 a substantial increase over any previous year of which data are available. There are probably several factors that have contributed to this decrease in volume of the maple sugar industry one of which is undoubtedly the deterioration of the trees through the inroads of disease and insect pests.

During the last three years a small tineid moth has become so abundant and its caterpillars have proved so destructive to sugar maples that the owners of many groves have become alarmed over the prospects of the destruction of their trees. Just what factors have contributed to the sudden and wide increase of this tiny pest during this period it is impossible to say. Nor can we predict with any degree of certainty when the natural factors which appear to hold it in check during most years will again come into the ascendency.

History of the Insect in New York State

The maple case-bearer was first noticed in New York State during the summer of 1850 by Asa Fitch who gave a brief and interesting but not complete account of its habits and ravages (1856). No reference can be found regarding it in New York from that time up to the year 1911 a period of about 60 years, when E. P. Felt (1912) mentions it as abundant and destructive near Bolton, on Lake George. Apparently the insect has continued more or less destructive over a considerable portion of the State since 1911 although it may have already reached its climax.

The Name of the Insect

When Fitch described the insect in his report for 1855 he called it the maple leaf-cutter and this common name has been used by most writers since. However, since the insect is rather closely related to other common case-bearers and since each caterpillar after its first period as a miner is never without its curious case and always lives within it, the name *maple case-bearer* is now proposed as the common name of the insect.

Like many other insects, the maple case-bearer has been named and described several times. Its history in this respect is shown by the following synonymy:

1856. *Ornix acerifoliella* Fitch. Second Rept. Nox. Ben. and other insects of New York, p. 269.
1861. *Incurvaria acerifoliella* Clemens. Proc. Ac. Nat. Sci's. Phil. for 1860, p. 5.
1873. *Tinea iridella* Chambers. Can. Ent., Vol. 5, p. 86.
1903. *Brackenridgia acerifoliella* Busck. Proc. Ent. Soc. Wash. Vol. 5, p. 193.
1904. *Paraclemensia acerifoliella* Busck. Jour. N. Y. Ent. Soc., Vol. 12, p. 177.

Distribution, Foodplants, and Injuries

Evidently this insect is widely distributed over the northeastern United States and southern Canada. It has been recorded from Vermont, New York, and New Jersey westward to Illinois in the United States and in Canada from the Provinces of Quebec and British Columbia.

The author has observed and collected it in the vicinity of Long Point, North Ferrisburg, and Burlington, Vermont, near Deposit,

N. Y., where it is abundant and injurious in a large sugar-bush and near South Colton, West Pierrpont, De Grasse, and Russell in St. Lawrence Co. in all of which localities it is seriously injurious. Felt has recorded it as abundant and injurious near Bolton, N. Y. It is probably widely distributed throughout the Adirondack region.

The author has never found the larvae on anything but the sugar maple although I have reared them to maturity on the red maple (*A rubrum*). Fletcher (1884) records the larvae feeding on the foliage of beech trees growing among infested maple trees after the foliage of the latter had been devoured.

The first indication of the presence of the insect in a grove is during the first half of June when the leaves begin to lighten in color owing to the multitudes of tiny blotch mines in which the young larvae have already eaten out the green tissues. The effect on the leaf at this time is certainly more serious than has been suspected. As many as 116 mines were counted in a single leaf in which a large part of the green tissues had been destroyed. After the mining period, which probably occupies about 10 days, the larva cuts out a small oval case and thereafter lives on the surface of the leaf, eating the epidermis and green tissues in a circle about the case as far outward as it can reach. Since the larva cannot reach the surface of the leaf directly beneath its case this oval area remains green and when the larva bears its case to a new location a disk-shaped green oasis, as it were, is left surrounded by an oval band of whitened and bleached tissue. Moreover, as the larva molts it cuts out each time a larger and larger oval piece of the leaf to add to its case. Thus it happens that in the latter part of July and first part of August the foliage of infested trees becomes brown with oval ring-like bands of bleached tissue and riddled with holes of varying sizes. A badly infested woodland will present in August and September a characteristic brownish appearance as though scorched by fire.

Felt (1912) records an area of woodland near Lake George of probably twenty-five acres as severely injured. Near Deposit, N. Y., a sugar-bush of ten or twelve acres has been severely injured for four or five years and during 1920 and 1921 it presented a striking and severely injured aspect during the late summer. Many of the younger trees in the central portions of this grove have been killed and the older trees have been so injured that the grove has fallen off markedly in its yield of sap during the last three seasons. In St. Lawrence County the maple groves are suffering severely from the work of this insect. Over much of the higher parts of the county the trees are

heavily infested and show marked injury. Owners complain of the falling off of their groves in production during the last two or three years.

Life History

Practically nothing is known of the life history and habits of this case-bearer except the notes made by Fitch on the larvae after they had formed their cases. The insect passes the winter as a pupa in its case on the ground among the fallen leaves. Here at Ithaca, in our breeding cages, the moths issued through the middle and latter half of May, beginning May 11 and continuing up to May 23. At Deposit, N.Y., I found the moths in great abundance on May 30, 1922, and many eggs had already been deposited by them. W. T. M. Forbes took the moths on May 17, 1922, at Trenton, N. Y.

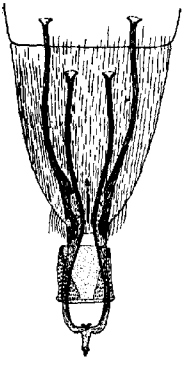


Fig. 10. Ovipositor of *Paraclemensia acerifoliella*, dorsal view.

The moth has a complicated extrusory ovipositor (Fig. 10) with which she deposits her eggs in tiny pear-shaped pockets in the tissues of the leaves just beneath the lower epidermis. The moth rests on the underside of the leaf with her abdomen bent forward beneath the body and with the tip pointing forward. With her body as a fulcrum she bores a tiny circular hole through the epidermis and forms a pear-shaped pocket in the tissues. In the larger end of this she places her egg (Fig. 11). The egg is soft, white, and elliptical, and measures about .45 mm. in length, .34 mm. in width and .24 mm. in thickness. It probably hatches in about one week, for on June 16, 1921, the larvae were in great numbers in the leaves and nearly ready to desert their mines, which many of them began to do the next day, the 17th. When the egg hatches the young larva begins at once to mine in the tissues of the leaf and continues to live as a miner for probably about 10 days. In general the mines are irregularly linear although each one tends to enlarge somewhat towards the terminus

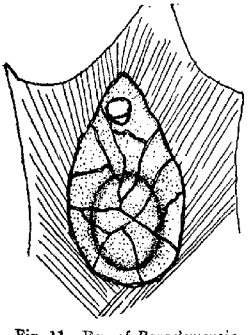


Fig. 11 Egg of *Paraclemensia acerifoliella* in a pocket on the underside of a leaf.

and to become a blotch. The mines are most conspicuous from the upper surface of the leaves and may be very numerous in a leaf. Counts were made of the mines in six different leaves and the number varied from 24 in the least to 116 in the worst infested leaf.

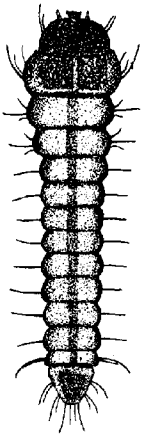


Fig. 12. Larva of *Paraclemensia acerifoliella*, a miner in a leaf.

The young larva is greenish-brown in color with a dark brown head. The body is somewhat flattened, the prothorax is broadened and the thoracic legs are present at least during the latter part of its life as a miner. The abdominal segments are prominently enlarged on each side, giving the appearance of a Coleopterous larva. When ready to leave its mine the larva is about 1¼ mm. in length (Fig. 12). The full-grown larva is about $\frac{1}{5}$ of an inch in length.

When the larva has completed its growth in the mine it cuts its oval case out of the mine. The larva then walks out on the leaf and deftly turns the case over so that the thicker piece from the lower epidermis is on top. The larva develops slowly, occupying nearly the whole summer to complete its growth. I am not yet sure of the number of instars and molts but head measurements indicate five molts. The final case of the larva in the fall consists of four oval pieces, two small inner ones and two large outer ones.

The process of cutting out a piece of the leaf for the case is an interesting one. The larva when feeding attaches its case to the leaf by short silken cords at intervals about the edges. These cords are composed of many threads spun in such a manner that they cross each other near the middle and form an X-shaped cord. When ready to cut out a new piece for its case the larva cuts a half-oval slit in the leaf which extends about half around the old case (Fig. 13). It then cuts a half oval about the opposite end of the case and later joins the ends of the slits, thus completing the circle. The new piece, however, is held in place by tiny strands of leaf tissue which the caterpillar leaves for supports. Later, when the larva is

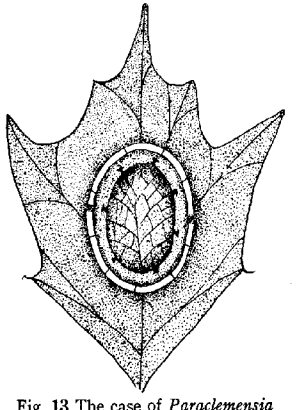


Fig. 13 The case of *Paraclemensia acerifoliella*, note the circle nearly cut around the case.

ready, it cuts these strands and walks out on the leaf where it dexterously turns the case over.

The Pupa

The pupae are light yellowish-brown in color tapering strongly to a point at the posterior end (Fig. 14). The larger ones (females?) are 4 mm. in length. The smaller ones (males?) average about $3\frac{1}{3}$ mm. in length. The appendages of the thorax and head are free and not glued to the body. On the dorsal side of the body there is a transverse row of short, stiff, brown, backward pointing spines on the 2, 3, 4, 5, 6, 7, and 8 abdominal segments. There are also two conspicuous filaments projecting forward from the head.

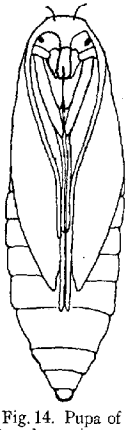


Fig. 14. Pupa of *Paraclemensia acerifoliella*. ventral view

The pupal case consists of four oval pieces, two larger outside pieces and two smaller inside ones. The two inner pieces are quite thickly lined with silk on the inside and between these layers the pupa is ensconced. The edges of the inner pieces of leaves are tightly fastened together with silk but an opening is apparently left at the anterior end of the cocoon as an exit for the pupa when it transforms to a moth. The large outer top piece of the case is loosely fastened and often falls off in handling. The larvae, in 1920 evidently transformed sometime during the month of October for on Nov. 2 when a box of leaves from Deposit were examined only pupae could be found.

The Moth

The moth has a wing expanse of about one-half an inch, some individuals exceeding this slightly and some not quite reaching it. The front wings and thorax are of an iridescent steel-blue color with a purple reflection while the hind wings are pale-brown and bordered with a fringe of long hairs. The fore wings are pointed and each bears a fringe of hairs on the outer third on both the front and hind margins. The head bears a tuft of bright orange-yellow hairs and the abdomen is dark-brown while the legs are whitish.

Seasonal History

The moths emerge from the pupae among the fallen leaves during May and deposit their minute eggs in the leaves. These hatch in a few days and the young larvae begin mining in the tissues between

the lower and upper epidermis of the leaves. Probably in about ten days to two weeks the larvae complete their work as miners and begin constructing oval cases which they cut out of their mines in the leaves.

The larvae live as case-bearers during July, August, and September falling with the leaves and changing to pupae within their cases. Here among the fallen foliage the pupae remain until the following spring. There is thus but one generation each year.

Methods of Control

Trees standing in a pasture where the leaves are blown away even though they were only a few rods from a badly infested woodland were scarcely touched by the insect. This suggests that if the leaves were raked in piles and burned or otherwise destroyed the pest could be held in check. This, of course, would entail considerable time and labor but if well done for once only the pest would be effectively checked for several years.

The only other feasible control consists of a thorough dusting of a grove with arsenate of lead by means of an airplane which now seems to be within reasonable possibility.

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ARTIFICIAL PRODUCTION OF HOPPERBURN

By F. A. Fenton and I. L. Ressler

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While there have been numerous tests made which have shown that *Empoasca mali* LeB is capable of producing hopperburn when placed on potato leaves, yet there has been comparatively little done in the way of inoculation tests with this insect. The writers conducted experiments during the past summer in order to observe the effects of the injection of leafhopper extract and of dilute poisons into the leaf tissue as well as to test out further the results of multilation of potato leaves, and were able to secure interesting data which may help toward the ultimate solution of this problem. Potato leaves were mutilated with various instruments, inoculated with dilute acid and alkali, and with water in which *mali* adults, nymphs or hopperburned tissue had been macerated. Also further tests were made in which these insects

were crushed on the leaf tissue or leaf petioles and in which the macerated leafhopper juice was drawn into the leaves by leaf transpiration.

WHAT IS HOPPERBURN

There are several types of injury found on potato leaves which are characterized by the death and turring brown of the leaf tissue. These have often been confused and described under the general term tipburn. The writers believe that much of the skepticism concerning the recent work on hopperburn is because of a failure to distinguish between these various leaf disorders. It therefore seems advisable at this point to describe briefly the injury which should be characterized as hopperburn and to compare it with other related leaf burns. Hopperburn always begins at the margin of the leaf and the burning is correlated with the veins. This relationship is not evident in older hopperburned leaves but is easily seen in the earlier stages (Fig. 15, 1-4) when the triangular or diamond shaped areas are seen to run in from the margin and to follow the veins. Other

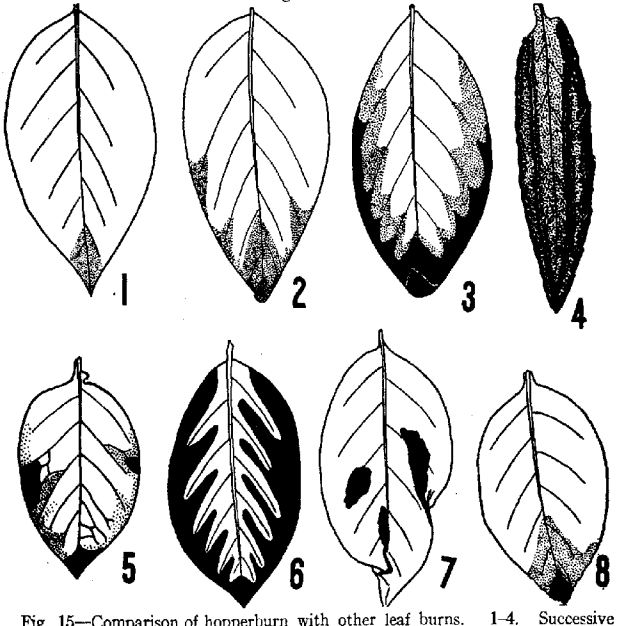

Fig. 15—Comparison of hopperburn with other leaf burns. 1-4. Successive stages of hopperburn; 5. tipburn (after Lutman); 6. scorching; 7. sunscald; 8. greenhouse burning.

characteristics are the deep brown color of the burned areas, the curling upward and rolling in of the leaf margin and the crisp, fragile nature of the dead tissue. Tipburn as characterized by Lutman (Fig. 15, 5) has no relation to the venation, a fact which distinguishes it at once from hopperburn. The writers are not familiar with this type of burning which apparently is not common in Iowa. Burn injury(Fig. 15, 6) is rarely seen in the field but can be produced experimentally by placing leaves near intense heat. The burned areas in this case always run between the larger veins, the tissue immediately surrounding these being the last to die. Sun-scald (Fig.15, 7) is fairly common in Iowa but is not serious. It is noticed usually before the first signs of hopperburn appear and is the result of the action of the sun's rays through drops of water resting on leaves after a rain. These drops of water, if they are not evaporated or blown from the leaf soon, act as minute burning glasses and the tissue beneath burns brown. This injury is not correlated with veins or margins. The leaf is also distorted in the affected region by being folded. Another type of injury (Fig. 15, 8) is commonly seen on potato leaves in greenhouses. It resembles hopperburn in that it is correlated with the veins and begins at the margin and it also often appears on the lower and older leaves of the plant. It is distinct from hopperburn, however, in that the tissue only turns a comparatively light brown, there is little or no curling upward and rolling in of the leaf, and the burned area is more or less leathery in texture. Leaves affected with this disease appear limp and wilted. This is discussed in more detail in the following paragraphs.

Effect of Mutilation of the Potato Leaves

Preliminary experiments on the effect of mutilation of potato leaves have already been mentioned.[1] This year these tests were repeated, using sterilized as well as non-sterilized instruments. The first series of tests consisted in pricking the larger veins with *minuten Nadeln*, once or several times both before and after these were sterilized. Seven days later the first signs of burning were noticed on several of the leaves so treated. This appeared in the form of a very small triangular brown area at the tip of the leaf and developed regardless of whether a sterilized or non-sterilized needle had been used. On the fifteenth day after the veins had been pierced all of the leaves but one showed this same type of injury.

Other leaves were similarly treated, using instead of the needles the fine, sharp ovipositors of two species of parasitic Hymenoptera.

[1]Fenton, F. A. Journal of Economic Entomology, Vol. 14, No. 1, pages 71-72, 1921.

Of the two types of ovipositors used, one, the larger of the two, was comparatively short and stout, while the other was longer, finer and more flexible. These were used both before and after being sterilized. After 15 days a small burned area appeared at the tips of some of the leaves but several remained normal.

Finally, several leaves were mutilated by severing one or more of the larger veins and the midrib with a scalpel both before and after sterilizing the instrument. Seven days after this test a small dead area was noticed on one of the leaves mutilated in this manner, but this did not increase noticeably after this date.

Discussion of Mutilaton Experiments

In the above experiments it was noticed that the first signs of burning appeared suddenly on different plants on the same day. Possibly some abnormal change in temperature or humidity occurred on this date which was the real cause of the sudden appearance of burning. The fact that some check leaves showed this type of injury seems to substantiate this conclusion. Furthermore, the burned areas on the mutilated leaves were very small, and not at all similar to hopperburn. They did not enlarge in size nor were they preceded by any yellowing of the tissue, loss of turgidity, or curling upwards of the leaf as always accompanies typical hopperburn. The writers have repeatedly observed similar small brown areas on leaves that were not mutilated in any way and believe that under the abnormal conditions which are present in the greenhouse, the older leaves on a plant are very apt to show these areas. They feel therefore that they have not succeeded in producing anything which is at all comparable to hopperburn by mutilation of the leaves and that it is certainly not produced by the mere mechanical injury following feeding or oviposition by the leafhopper.

Effect of Dilute Poisons on Potato Leaves

Potato leaves were injected with five per cent hydrochloric acid and others with five per cent ammonium hydroxide by means of a hypodermic needle. Within 24 hours these leaves were wilted and shrivelled but there was no sign of burning. After this the leaves dried and the dead areas gradually turned a light brown color but the injury was in no way similar to hopperburn. Check leaves inoculated with water blanks remained normal.

Inoculation of Hopperburn Tissue Solution into Potato Leaves

On July 18 a small amount of solution prepared from a macerated potato leaf showing a trace of hopperburn was injected

into normal potato leaves. Other leaves were injected likewise with a solution prepared from a leaf showing advanced stages of this disease. Finally, leaves were inoculated with a solution prepared from a leaf that had been killed by hopperburn. By July 25 some of the leaves showed a slight browning at the tip and on July 30 all showed this same type of injury. On August 10 this experiment was closed as the injured area on the inoculated leaves had not increased and they were clearly not affected with hopperburn. The injury in this case was identical with that resulting from multilation and was probably a result of greenhouse conditions.

Inoculation of Potato Leaves with *E. mali* Extract by Means of a Hypodermic Needle

On July 19 approximately 100 *Empoasca mali* adults of both sexes were collected and macerated in 10 cc. of water that had been previously distilled and sterilized. Three potato leaflets were inoculated with the liquid drawn off from this solution and also the petiole of a single leaf was inoculated in the same manner. On July 25 there was a scar or lesion noticed in the mid-vein of each leaf where the needle had been pricked in. At the same time two of the leaves showed decided burning similar in every way to hopperburn, while the third showed the burning less distinctly. The injury increased daily and on July 30 there was no question but that a disease very similar to hopperburn had been produced in every case. On July 29 the above experiment was repeated, using in these inoculations a solution made from 58 adults of both sexes. Part of the leaves in this test were reinoculated 24 hours later by a freshly prepared solution made from 56 adults of both sexes. In this latter test a slight burning was produced but it was in no way comparable to the injury obtained by the first set of inoculations. Although fewer insects were used this was more than compensated for by the additional inoculation the following day.

On July 19 approximately 88 nymphs mostly in the fourth and fifth instars were macerated in 10 cc. of water that had been previously distilled and sterilized. Four inoculations were made of which three were in leaf tissue and one in a leaf petiole. Only one of the leaves so treated showed any signs of hopperburn injury, and on this one there was a small brown area at the tip. In all cases, however, there was a marked lesion produced at the point of inoculation. Here the tissue seemed to collapse and the mid-vein became distorted. In dried specimens these lesions are very distinct, showing that the nymphs

must have contained a toxic principle. Inoculation of check leaves with water blanks failed to produce injury.

Inoculation of Potato Leaves by Needle Punctures

On July 27, 80 nymphs in advanced stages were macerated in a small quantity of water. Small drops of this solution were placed on the under surface of the leaves and then using a very fine needle, the leaves were punctured 25 times. This procedure was repeated July 28, 29 and 30. July 31 one leaf so treated showed a slight burning at the tip but the others were normal. August 2 all leaves so treated but one showed a slight curling. August 10 this experiment was closed, there being no sign of hopperburn on any of the leaves, although there was a large scar at the point of inoculation.

Inoculation by Means of Crushing the Nymph on a Leaf Abrasion

Having failed to get positive results in the above tests, it was decided to crush the live insects on the leaf, making in so doing a cut in the leaf surface. Three fifth instar nymphs were crushed near a large side vein of one leaf; one each day, on July 27, 28 and 29, respectively. At each point of inoculation the tissue turned yellow and then brown, but the injury was very localized and the rest of the leaf remained perfectly normal. A second leaf received the same treatment except that on the first day a fourth instar nymph was used and the results were the same. Thirteen nymphs in various stages were crushed on a third leaf during a three day period and in this experiment the injury was much more noticeable. Not only did the tissue immediately beneath the crushed nymph turn brown but also the area surrounding it was affected in the same way. This was proof that the nymphs contain a toxic substance but in small quantities.

Inoculation of Potato Leaves by Leafhopper Residue

On July 29 the residue left over from 58 crushed adults in the needle inoculation experiments mentioned above was placed on potato leaves and leaf petioles and pricked in with a fine scalpel. Twenty-four hours later the tissue beneath had whitened and there was a decided lesion. However, the injury continued to remain localized and the leaves were apparently little affected by this except in one case. Here the lesion on the petiole was so pronounced that it was nearly girdled. This experiment demonstrated that the adults apparently possess the same toxic substance as the nymphs and further it partially explained the lack of better results in other inoculation tests; namely, that the mere

crushing of the insects apparently fails to dissolve enough of this toxic substance to produce injury in all cases.

Experiments with Potometer

It was thought that it might be possible to get more of the leafhooper solution into the leaves by cutting them off and placing the stems in the solution so that it would be drawn up into the leaf by transpiration. Accordingly, a number of hollow glass tubes were bent into a "U" shape, a rubber tube was placed securely over one end of the glass tube and then into this rubber tube the stem of an entire leaf was firmly placed and held there by grafting wax. After trying this out and finding that most of the leaves remained fresh for some time under these conditions with water in the tube, a solution made from 50 crushed nymphs was poured into one of the tubes. The diameter of the tube was so small that it was possible to fill it with a highly concentrated extract. As this was darker colored than the water it could be easily seen that the extract was being drawn up into the leaf which promptly became flaccid and remained so without entirely wilting for five days. At the end of five days, on August 29, the leaf was removed. It had yellowed in certain areas, and there had been a tendency for the margin to roll up, a condition similar to the beginning of hopperburn. It was found that the cut end of the stem had partially decayed, a condition brought about by the fermentation of the insect remains in the water. The decayed part was cut off and the leaf placed with the stem in water. It soon freshened up and August 31 the leaf had recovered except in the injured portion. The injury resembled hopperburn very closely. Leaves in plain water remained perfectly fresh and showed no injury throughout this test, provided the apparatus was working properly. This experiment was repeated later with the difference that only the clear solution free from the insect remains was used, thus avoiding decay of the leaf due to fermentation. The leaf became flaccid as in the other case and then developed symptoms of hopperburn.

Discussion of Inoculation Results

The writers were at a loss at first to understand the variable results in the different inoculation tests with hypodermic needles as described in the preceding paragraphs. It was noted, for example, that extracts from crushed adults caused marked symptoms of hopperburn in one series of inoculations and negative results in another. Furthermore, it was noted that extract from crushed nymphs produced less abnormalities in the leaf tissue than from the macerated adults. This would indicate that

the nymphs contained less of the toxic substance than the adults, a fact not born out by previous experiments[1], where it was shown that the nymph is the more toxic of the two. Undoubtedly some difference in procedure not noted at the time may have been the cause of this. Failure to produce burning in all cases may have been due to inability to force enough of the liquid into the plant by means of the hypodermic needle. This represented a real difficulty in our earlier inoculation tests as the natural turgidity of the leaf made it almost impossible to force much of the extract in. The difference in the amount of extract injected into the leaves as a result of this turgidity may explain the difference in the effects of the toxin in the leaf. That the negative results of the earlier experiments may have been due to the failure to introduce enough of the hopper extract to produce burning because of the natural turgidity of the leaves is also indicated by the success of the tests with a potometer. Another factor entering in was the difficulty of getting very much of the toxic substance into solution by a mere maceration of the insects in distilled water. Apparently not all or perhaps not even much of the toxic substance was extracted by this method as was indicated by the highly toxic action on potato leaves, of the residue composed of macerated insects after the clear solution had been drawn off. That the live nymphs do contain this toxic substance was demonstrated a number of times by crushing them over a leaf abrasion. Very distinct lesions as already described resulted in every case.

The above tests need to be repeated on a larger scale and some better method devised for getting the toxin into the solution. Furthermore, extracts prepared from other insect species should be injected into the leaves as it is well known that insect sera often contain toxic principles.

EFFECT OF BORDEAUX MIXTURE ON *EMPOASCA MALI*

By F. A. FENTON AND ALBERT HARTZELL, *Iowa State College, Ames, Iowa*

Since the establishment of the fact that *Empoasca mali* LeB. is the cause of potato tipburn, it was found that Bordeaux mixture in some way prevented this foliage disease by its action on this insect. It was thought at first that it acted as a repellent[2] because plants sprayed with this fungicide were noticed to have comparatively few leafhoppers on them. The senior author[3] demonstrated later that this com-

[1]Fenton, F. A. loc. cit. pages 76-77.
[2]Fluke, C. L. Journal of Economic Entomology, Vol. 12, 1919, pages 256-257.
[3]Fenton, F. A. Journal of Economic Entomology, Vol. 14, 1921, pages 71-79.

pound acted as a repellent to the adults, the latter preferring to oviposit in unsprayed leaves when given a choice. Still further tests this year have also shown that while oviposition will take place when females are confined with plants completely covered with Bordeaux, yet very few eggs are laid under such circumstances.

TABLE I.—COMPARISON OF OVIPOSITION OF *E. mali* ON PLANTS COMPLETELY SPRAYED WITH BORDEAUX MIXTURE AND ON THOSE PARTLY SPRAYED

	Entire plant sprayed	Plant partially sprayed		Unsprayed check plant	Totals
		sprayed leaves	Unsprayed leaves		
No. females used	36	24	24	12	72
Total No. eggs aid	42	27	147	155	371
Average eggs per emale	1.5+	1+	13—	6+	

The above table summarizes results obtained in 22 experiments in which a total of 72 fertile females were used and 371 hatchings obtained. In these tests the insects were all examined under a lens to see whether they were gravid or not and only the former were included in the tests. The same number was placed in each cage on plants that were known to be free from *mali* eggs from other sources. All insects were removed after a ten days' period and the hatching young were counted daily. Where there was a choice between sprayed and unsprayed leaves by far the majority of eggs were laid in the latter, the ratio being approximately six eggs per female for the ten day period in unsprayed leaves as against one egg per female in the sprayed. Where no choice was given the average was slightly higher on the sprayed leaves but here there were always some eggs laid in the unfolding leaves at the tip of the plant which were unavoidably partly or entirely free from the spray.

It was then decided to test out the action of Bordeaux mixture on these insects in more detail. Potato plants were sprayed thoroughly with this compound. Both the 4-4-50 self-prepared formula and several commercial dry Bordeaux powders that were mixed with water were used. Single leaves from plants thus treated were placed in shell vials with individual leafhoppers. It was soon observed that there was a surprising mortality among the nymphs and as a result more vials were started, the exact instar of the nymph in each case being noted. The following table is shown to illustrate one experiment out of several that were conducted. In all about 100 insects were used in these tests and the writers feel that the results although preliminary are yet of sufficient interest to be presented here.

TABLE II.—EFFECT OF BORDEAUX MIXTURE ON *Empoasca mali* NYMPHS

Instar	No. days lived			No. insects used
	Min.	Max.	Average	
1	1	4	2.3	10
2	3	4	3.4	5
3	2	7	3.9	7
4	2	7	4.4	7
5	3	9	6	7

In not a single case did any of the nymphs feeding on sprayed leaves become adults. In some instances the insect would moult once but very often death occurred directly after the casting of the exuvium or even before the nymph could completely extricate itself. Bordeaux mixture acted comparatively slowly, some of the older nymphs living as long as nine days. In general the younger the insect the quicker death resulted upon being confined on a sprayed leaf, the length of time ranging from approximately two days in the case of the first instar to about six for the fifth.

Careful observation disclosed the fact that the nymphs were not dying from starvation because they were either unable or refused to feed from the sprayed leaves. Once placed on a leaf well coated with Bordeaux, the hopper at first wandered about but sooner or later settled down and began to feed. In fact, very often the dead nymph would be found with its proboscis firmly fixed in the leaf tissue. Often twenty-four hours or more before death the insects would become affected, appearing sluggish and partly paralyzed. The fact that they were confined to shell vials apparently had little to do with it because in almost every case the nymph could be raised to maturity under these conditions on unsprayed leaves. Nymphs placed on sprayed potted plants in the insectary soon disappeared but whether they died or not is a question.

Similar tests with adults were carried out but as yet our data is insufficient on this subject. In the few vials observed some adults lived for over two weeks and this would appear to show that Bordeaux mixture is at least not very toxic to the adults and possibly it may not affect them at all in this respect.

FIELD EXPERIMENTS

The insecticidal value of Bordeaux mixture in the control of the potato leafhopper was also shown by results obtained from field plots at Ames. These plots consisted of a number of rows of potatoes of two varieties, namely: Green Mountain and White Blossom Irish Cobbler. These rows were sprayed with self-prepared Bordeaux mixture 4-4-50 formula alone and also in combination with black leaf

40 added at the rate of 1¼ pints to every 100 gallons of spray.[1] Applications were made June 17, June 28, July 7 and July 19, the spray being applied with a ten-gallon capacity hand pump.

Three plants were selected, one from each variety and one as a check, and the hatching leafhoppers were counted and killed daily. A total of 822 nymphs hatched from the Green Mountain, 864 from the Irish Cobbler, and 2573 from the check, the ratio of the counts on the unsprayed as compared with the sprayed being about three to one. This did not represent the actual control as the young first instar nymphs were removed directly after hatching and before the Bordeaux mixture could act on them. That this must have been the case was illustrated by the fact that on other sprayed plants only a few of the nymphs in the fourth or fifth stages were found. This indicated that comparatively few of the young survived after hatching from these plants and only because they were able to feed on unsprayed leaves, many of which could be found on the vines no matter how carefully they were sprayed. These daily counts also showed that this material was cumulative in its effects, there being a decrease in the leafhopper population which continued from day to day due, as cage tests showed, to the repellent action on the ovipositing females and the toxicity to the nymphs.

EXPERIMENTS ON THE BIOLOGY AND TIPBURN DISEASE OF THE BEAN LEAF-HOPPER WITH METHODS OF CONTROL. (*EMPOASCA MALI* LE BARON)

By A. H. Beyer

The Bean Leaf-Hopper is generally distributed over the State of Florida, and is one of the most important insect enemies of the bean and other crops growing in the trucking sections of the state. The northern portion of the state, including Gainesville where the writer conducted his biological studies and experiments on control, during 1921, there was found to be an over-wintering period, while southern Florida including the latitude at least as far north as Plant City, where it was quite apparent that there is no over-wintering period. According to a survey which was made in early February the following facts were revealed: all stages of the life cycle were collected from the castor bean host, and an outbreak was recorded on garden beans (*Phaseolus vulgaris*) at Miami, Florida as early as March 24. The earliest outbreak in the

[1]The addition of nicotine sulfate did not increase the toxicity of the Bordeaux sufficiently to make any difference in counts between the two plots.

northern part of the state, occuring on cowpeas, was August. 20th. Thus it is evident that the conditions regarding seasonal history differ widely in Florida.

Seasonal History

The Bean Leaf-Hopper was first found feeding in the field on March 8, where it was collected abundantly on the poke weed (*Rivina humilis*) which was growing in fence corners. The Adult stage was observed feeding on the lower foliage and the largest percentage of those recorded were females, however a considerable number of over-wintering males still remained. In fact some mating was observed from these individuals. The females were placed in small, glass cylinder cages one inch in diameter, well ventilated and containing small plants for food, where they could be kept under close observation with hand lens and binocular. Egg scars were first found on the leaves March 10, and on March 18 the first nymphs were recorded.

Following is a series of generations as recorded in the outdoor laboratory at Gainesville during 1921:

Experiments:

March 11	May 2	52
May 2	June 20	49
June 20	August 5	46
August 5	Sept. 30	56
Sept. 30	Nov. 28	60
Nov. 28	Dec. 15	Feb. 27th, 1922

Making a total of six generations for the season.

The maximum number of nymphs produced per female	131
The minimum " " " " " "	22
The average " " " " " "	59.3

The length of life of the adult ranged from 32 to 64 days during summer flight. The incubation period ranged from 5 to 9 days.

The Influence of Climatic Factors

The temperature for the year of 1921 reached a maximum of 101 degrees F. during June and a mean maximum of 86.3 for the season, which was above the normal temperature for the latitude of Gainesville. The summer was dry and hot with the exception of June which had about a normal precipitation of 5.70", while July was above normal having a rainfall of 15.03", and October with 6.03" was about normal.

Since the Bean Leaf-Hopper has been recorded as reaching its optimum development during hot dry weather, it is evident that this species experienced a quite favorable season for its development, however,

the long dry periods caused much of the early beans to perish which resulted in the destroying of countless numbers of immature stages while the adults sought citrus and shade trees in quest of food.

Tipburn On Beans

It was noted after a few days colonization of the nymph stages on young bean plants, which were grown under insect proof cages, that the tips of infested plants were affected in a manner similar to that caused by spray injury, the adults and nymphs feeding on the mid-veins and branches caused them to collapse, later the tip and margin generally turned upward and took on a Vandyke Brown color as it rolled inward at the edges. The area remaining inside of this rolled margin turned to a pale brown color and, where light infestations occurred there remained small patches of green near the stem end of the leaf. In a light infestation the rolled margins of the leaves would sometimes become broken and fall off, giving the leaf a ragged appearance and still a portion of the leaf would remain green unless it continued to be infested. In severe cases the leaves usually all become dry and drop to the ground and nothing remains standing but the main stem. The kind of soil as well as sunlight did not seem to be of any importance in minimizing burning on the bean plants, hot dry weather seemed to hasten its developement while humid weather and moist soil retarded its development. Numerous variety tests were made but none showed any particular resistant characteristics except some of the pea bean varieties.

Natural Enemies

It was observed that this species was preyed upon by few natural enemies. Several species of spiders occasionally entangled an adult or nymph in their webs, and a species of mite was found feeding on the nymphs. The common small red ant (*Dorymyrmex pyramicus*) was noticed at frequent occasions as being predaceous upon the nymph stages

Commencing in July the Parisitic fungus (*Entomophthora sphaerosperma* Fresenius) was noted to be attacking both the adults and nymphs of this species. When the disease was contracted they die in several day in the adult with the wings expanded and the conidia bearing threads coalescing over the body, especially the softer or fatty parts but often covering the chitinized portions as well. The host after death turns to a pale yellowish tint, while the fungous growth or mat becomes flattened on the upper surface with the color varying from white to Nile green. The writer has experienced some success in artificially cultivating and disseminating this fungus.

Method of Control

The most difficult problem which was experienced regarding control was the wide range of host plants of E. mali. Since rotation is out of the question, and clean culture being of little value, after persuing a series of spraying experiments it was concluded that equally as much importance is to be attached to the method and kind of apparatus used as upon the formula itself. Therefore, the writer has, after a series of experiments, designed a sprayer attachment for truck crop insect control work which rendered better results for Leaf-Hopper control than any other available equipment which was first tested out with poor results. The time when the spraying was started was found to be very important as the Leaf-Hoppers attacked the plants as soon as they had formed leaves. Since the Leaf-Hoppers attack the lower sides of the leaves it would seem that only the lower sides would require an application of spray. As a matter of fact it was observed after a number of spraying experiments had been completed, where only the lower side of the leaves were being sprayed, that often nymphs and also the adults, if they did not take flight when molested, would assume their sidewise running habit and pass over the margin of the leaf to the upper side of the leaf in quest of protection and would later resume feeding when a suitable place was found which had not been thoroughly sprayed.

A New Spraying Device Designed by the Writer

This device contains three wide angle mist spray nozzles, all of which are connected to a common hose which is attached to pressure pump and sprayer tank. These nozzles are enclosed within a canvas covered cylinder at least 36 inches in length and 24 inches in diameter. This cylinder contains an opening 8 inches in width and running full length of the cylinder. The opening is turned downward and serves as a passage for the base of the plants, as the cylindrical enclosure enveloping the plants passes over the row. A wide angle mist nozzle centrally located in the top of this cylinder directs the spray downward on top of the foliage. Two wide angle mist nozzles located, one on each side of the 8-inch opening and midway between the ends of the cylinder, which are adjustable to direct the spray either inward into the row of plants or upward, thereby making it possible for the spray to make a thorough contact with the lower side of the foliage. The ends of this cylinder are enclosed with an adjustable iris curtain so that the aperature can be adjusted according to the needs and the size of the plants.

Some Advantages Over The Common Method

1. It was found to prevent escape of insects when spray was applied to the plants.

2. Preventing their escape usually resulted in their being killed by eithre contact with the spray or its colliodal vapor fumes which were formed from the combination of nicotine sulphate and whale oil soap.

3. It is adaptable in making a thorough application of spray on the smallest plants because two nozzles are adjacent to the ground; an important factor in the fall bean control work, as the leaf-hoppers colonize soon after the first leaves are formed.

4. By holding or confining spray close to the plants within the enclosure, the greatest efficiency and economy is produced by the spray, its vapor and fumes.

5. This spraying device can be operated successfully as fast as a horse usually walks. An acre was sprayed in one hour, and with power or traction sprayer it can be operated by one man.

The writer plans to add some improvements to this apparatus and also make it adjustable for dusting work as well as liquid and volatile sprays.

The following table summarizes results of some experiments where new design sprayer was used.

SPRAYED TESTS WITH CHECK ON CONTROL OF BEAN LEAF-HOPPER AND TIPBURN

Plat. No.	Spray Material	Distribution	Date Applied	100 Plants	Adults & Nymphs killed Percent	Control of Tipburn Percent
1.	Check, unsprayed	0	0	0	0	0
2.	Nicotine Sulphate (40%)	1-1000.	Sept. 15	"	90	75
3.	Nicotine Sulphate (40%) & Whale oil soap	1-1000 1 lb.	" "	61	95	89
4.	Whale Oil Soap	10 gal. H_2O 1 lb.	" "	"	71	70
5.	Bordeaux Mixture	4-4-50	" "	"	42	95
6.	Bordeaux Mixture Nicotine Sulphate	4-4-50 1-800	" "	"	85	95
7.	Kerosene Emulsion	7%	" "	"	81	66

Owing to the dry season six sprayings were applied at intervals of about a week apart. The spray material was applied at a pressure of 200 pounds. After summing up the results on spraying tests the Nicotine Sulphate and whale oil soap gave the best results with the Bordeaux mixture, Nicotine Sulphate giving the next best results.

EXPERIMENTS WITH CONTACT INSECTICIDES FOR THE CONTROL OF THE JAPANESE BEETLE (*POPILLIA JAPONICA*)[1]

By B. R. LEACH and F. J. BRINLEY *Riverton, N. J.*

During the summer of 1920, while engaged in testing various insecticides, the writers noted the fact that a soap solution killed the

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Japanese beetle by contact. A series of tests were accordingly conducted during the season of 1920 and 1921 in order to determine the factors influencing the use of soap alone and combined with other materials when employed as a contact spray for the control of the Japanese beetle, and the Rose beetle (*Macrodactylus subspinosus*).

An efficient contact spray will no doubt have considerable application in the control of the Japanese beetle at this time, due to the fact that a suitable arsenical spray has not as yet been developed. The gregarious feeding habit of the beetle is also conducive to securing a large kill by the use of a small quantity of contact spray on a limited amount of foliage, since the beetles cluster thickly on grape vines, sweet cherries and smartweed, mainly feeding exposed on the upper surfaces of the leaves where they are readily wetted by a contact spray.

Materials Employed

During the course of the experimental work the writers tested the various types of soaps. These included fish oil, rosin fish oil, laundry, borax, sodium hard and soft, and potassium soft soaps. The results indicate that the type of soap is not as important as is the concentration of the spray solution although certain types of soap are better adapted to this purpose than others. Laundry soaps, for instance, when used, at the necessary concentration, will not remain entirely in solution. They tend to form a thin jelly of rope-like consistency thruout the liquid, even when agitated. This is not the case with certain grades of sodium and potassium soaps manufactured from vegetable oils, such as soja bean oil. When this soap is dissolved in hot water and diluted to spray strength the solution does not gel, but remains in solution even on cooling. It is important to use a soap which does not gel in solution at spray strength, otherwise the spray solution is

Table I. Results Obtained With Various Types of Soaps in Solution When Used Against the Japanese Beetle

Type of Soap	*Lbs. of Soap to 50 gal. water*	*P. C. Killed*	*Remarks*
Fish Oil	1-10	———	Inferior kill even at high concentrations
"			"
Rosin Fish Oil	1-10	———	
White Laundry	2	45	Soap tended to gel.
"	5	50	Gelled badly
Yellow Laundry	2	0	Strong tendency to gel.
"	5	45	"
Borax	2	0	"
"	5	30	"
Sodium Soja Bean	2	10	No tendency to gel.
"	5	42	"
"	6	55	"
"	8	82	"
"	10	90	"
Potassium soja Bean	2	10	"
"	4	25	"
"	6	40	"
"	8	50	"
"	10	80	"

uneven in concentration and does not give a constant kill throughout the area sprayed.

The results obtained from the use of various types of soap are given in Table 1. The spray was applied during the heat of day when the beetles were active.

The results indicate that the laundry, rosin fish oil and fish oil soaps are not fitted for this purpose. It will be noted that the efficiency of the sodium and potassium soaps is in proportion to the concentration of the spray solution. In warm weather sodium soja-bean soap at the rate of 10 pounds dissolved in 50 gallons of water gave invariably 90% kill. Potassium soja-bean when used at the same concentration resulted in a slightly lower mortality.

The effect upon the individual beetle when it comes in contact with the spray is pronounced. The conspicuous coloring of the insect is obliterated and it assumes a dull grayish black appearance. The legs straighten out, no violent movement takes place and death sometimes occurs within thirty seconds. The complete mortality takes place within a few minutes. Some of the beetles fall to the ground, while others remain hanging to the leaves by their tarsal claws.[2]

Addition of Materials to Soap Solutions

During the course of the experiments a number of materials were tested in this connection alone and with the soap solutions. These materials are included in the following list:

Sodium ploysulphides	Worm seed oil
Sodium thiosulphate	Pine oil
Carbon disulphide	Lemon oil
Acetone	Toluene
Castor Oil	Sulfur
Gum arabic	Fusel oil
Methyl alcohol	Potassium sulphide
Kerosene emulsion	Linseed oil
	Nicotine sulfate

The results indicate that the materials alone were of little or no value in this connection, and when these materials were added to the soap solution they did not improve the efficiency over that of the soap alone. Seemingly of all the materials tested, only one was active; namely the *soap*. For this reason the use of rosin fish oil or fish oil soaps is

[2]During the course of the work the materials enumerated in this paper were tested against the Rose beetle (*Macrodactylus subspinosus*). The results were substantially the same as those with the Japanese beetle.

of doubtful value in this connection, because these materials themselves are mixtures of soaps and other materials, of which the soap alone is toxic.

Factors Influencing the Treatment

The experimental results indicate that temperature is the limiting factor in the use of this treatment. The best results are secured by spraying when the insects are exposed to the sun during the heat of the day. Under these conditions a consistent kill of 90% of the beetles was obtained whereas simultaneous spraying of beetles in the shade never resulted in more than 50% mortality.

In applying the material the best results are secured by using a coarse nozzle and sufficient pressure to thoroughly wet the foliage.

The sodium and potassium soja-bean soaps are now selling at 8 to 9 cents per pound and at the present price of these materials it costs from 80 to 90 cents for 50 gallons of spray.

The experimental work with these materials has been confined entirely to field tests and observations and under the circumstances no explanation can be offered at this time regarding the physiological action of the material upon the insect.

LARVAL FOOD HABITS OF THE JAPANESE BEETLE (*POPILLIA JAPONICA* NEWM.)[1]

By Loren B. Smith, *Riverton, New Jersey*

For several years it was believed that the larvae of the Japanese beetle fed largely on decaying vegetable matter in the soil.[2]

Observations made during the present season indicate that while a certain amount of humus and mineral matter passes through the digestive tract, the larvae feed principally upon the living roots of various plants.

Field Observations

During April and May, 1921, the writer observed the larvae actively feeding on the roots of rye, clover, and several of the pasture grasses. Further observations made in fields of rye disclosed the fact that in nearly all cases the larvae were congregated about the roots of the rye stools. The larvae have also been found feeding on the large tap-roots of clover, some of which were nearly eaten through between

[1]Published by permission of the Secretary of Agriculture of the U. S. Dept. of Agriculture and New Jersey Dept. of Agriculture.

[2]Davis, J. J. Green Japanese beetle. New Jersey State Department of Agriculture. Circular No. 30. p. 14. 1920.

one and two inches below the crown. The larvae do not confine their attacks to grasses and legumes, since records have now been obtained of their feeding on the roots of such plants as iris, peony, gladiolus, arbor vitae, small conifers, as well as other ornamental plants and shrubs, and also on the roots of corn, beans and tomatoes.

The first injuries to grass sod which were noted occurred in a pasture in which the abundance of the larvae was between 150 and 200 to the square yard. Areas were injured to such an extent that the sod could be easily rolled up with the fingers. Many of the plants which did not have the roots entirely eaten off by the grubs were killed by the hot, dry weather which ocurred later in the season. Many weeds and coarse rooted grasses do not show any appreciable effects from the feeding of the larvae, whereas the finer rooted species such as blue grass and red top are killed. For this reason it is probable that the most important injury by the grubs will not usually result in the destruction of the sod, but rather in the killing out of the more desirable species of grasses for pasture or hay purposes, and their being replaced by less desirable species.

Golf courses offer particularly favorable situations for the development of *Popillia japonica* larvae. The Country Club course at Riverton, New Jersey was found to be generally infested with the grubs early in the Autumn of 1921. On the fairways and in the rough the infestation was variable, on an average of a number of diggings less than fifty larvae were found to each square yard. On several of the putting greens the larvae were very numerous, as high as one grub to the square inch being found. The grass was killed in limited areas on someof the greens. That the greens were not more seriously injured was probably due to the fact that they were regularly watered and rolled. Aside from the direct injury to the grass roots, the playing surface was rendered soft and spongy by the burrowing of the insects in the soil. It was noticeable that the most severe injury to the grass occurred on the higher portions of the greens and especially about the margins. These would probably be the places which would receive the least water when the greens were sprinkled. Much of the feeding on the greens was done close to the surface of the ground, the larvae in most cases occurred between ½ inch and ¾ inch deep.

Feeding Habits

The feeding habits of the larvae have been observed many times both in the laboratory and in the field, and have been found to differ somewhat from those of certain of our native species. The larva

forms a cell in the soil slightly larger than its body and feeds on the fine rootlets at the top or bottom of the cell. The grubs usually follow the course of the rootlets until these are consumed before attacking others. It is this habit of feeding which has prevented the injury to grass from being extremely serious, since it is only in areas of heavy infestation that many plants are found which have all of their roots destroyed. It also follows that in areas which suffer from drought the injury has been the most noticeable and severe.

The general movements of the larvae in the soil are vertical, whereas the larvae of *Cyclocephala immaculata* and *Anomala* sp., which are abundant in this region, usually feed and move in a direction parallel with the surface of the ground. During the seasons when the *Popillia japonica* larvae are feeding they occur in the soil at depths varying between ½ inch and 3 inches. For a short time before the grubs descend on the approach of cold weather in the autumn and again during the period immediately preceding pupation, the depth at which the various individuals are found is more uniform.

Thigmotropism

The larvae are positively thigmotropic to living roots and if these are not available, to stones, sticks, or to the bottom or sides of the breeding cage. The larvae have been found abundantly beneath stones in the field and for a distance of two or three feet from these stones no larvae could be found, although at a distance of five or six feet from the stones there would be twenty to twenty-five larvae to the square yard. In a young peach orchard which was cultivated the previous season and allowed to remain fallow over winter, there were numerous chickweed plants growing in the Spring of 1921. In the spaces between these plants the ground was bare. Fifty plots, each three square feet in area, were examined where no vegetation occurred and no larvae were found. On the removal of fifty chickweed plants an average of 7 larvae were found at the roots of each plant

Examination of the Contents of the Fore Intestine

Dissections were made of a large series of larvae collected in grass sod and the contents of the fore part of the alimentary canal were carefully removed. It was found that the material eaten by the insects was composed of small soil particles, fresh plant tissue, and small pieces of plants which were partially decomposed. In order to determine the approximate amount of plant tissue as compared with the mineral matter eaten by the larvae, four samples of about five grams

each were collected from the fore intestines of the grubs. These were dried, weighed, ignited and weighed again and the loss from ignition considered as representing the approximate proportion of plant tissues, by weight to the total material found in the fore intestines of the insects. The loss by ignition of the soil from which these larvae were collected was about equal to the per cent of ash in the grass roots and for our purpose these factors can be considered to offset each other. These figures indicate that plant tissues constitute about 67.33 per cent. by weight of the total material consumed by the larvae.

ANALYSIS OF MATERIAL EATEN BY LARVAE OF *P. japonica*

Total weight of food collected	21.4134 grams
Dry " " " "	15.4769 "
Ash remaining after ignition	5.0556 "
Loss from ignition	10.4213 "

Examination of the material contained in the fore part of the alimentary canal indicates the soil particles and pieces of plant tissue to be relatively uniform in size. The greatest variation occurred in those tissues which were partially decomposed. The following data on the extremes in size of particles found in the fore intestine are in each case based on fifty measurements:

Fresh plant tissue	minimum length	0.45 mm.
	maximum "	1.22 mm.
Fresh plant tissue	minimum width	0.25 mm.
	maximum "	0.36 mm.
Soil particles	minimum length	0.72 mm.
	maximum "	1.125 mm.
Soil particles	minimum width	0.327 mm.
	maximum "	0.875 mm.

In order to determine the relative number of pieces of fresh plant tissue, decaying vegetable matter and particles of soil composing the aggregate in the fore intestines of the larvae, determinations were made of the number and character of the particles obtained from twenty-five grubs. The larvae were collected from grass sod May 20th, killed by dropping in boiling water, and dissected immediately afterward. To separate the fresh plant tissues from those which were dead or partially decayed, it was necessary to stain and compare the cellular structure of the pieces found in the insect with the structures in fresh root tissues taken from the plants where the larvae had been feeding. The following tabulated statement indicates the approximate number and character of the particles of material found in the fore intestines of the larvae:

Total number of pieces of fresh plant tissue	1375	64.3%
" " " " " decayed plant tissue	419	19.0%
" " " " " mineral matter	344	16.0%

From the figures given it will be seen that from twenty-five larvae approximately 84.0% by volume of the material eaten was vegetable matter, and 64.3 per cent. of the total amount of material consumed was from the roots of living plants.

In an experiment started May 2, 1921, 200 three-ounce tin boxes were filled with the following materials and one larva placed in each tin. The object was to note the effect on the larvae, as shown by the mortality, of the presence or absence of living plant roots in the soil. Fifty tins were filled with rich sifted garden soil. Fifty tins were filled with sifted subsoil taken at a depth of four feet, containing 1.45 per cent of organic matter. Fifty tins were filled with subsoil to which was added pieces of partly decayed grass roots from which the soil had been washed. Three weeks after the experiment was started the tins were examined and the number of live and dead larvae were noted. Replicate series were conducted in the autumn using young larvae. The results obtained were similar. The following tabulated data gives the results obtained.

	Number dead in three weeks.	Per cent.
50 larvae placed in garden soil	27	54
50 larvae placed in subsoil	44	88
50 larvae placed in subsoil and decayed roots	22	44
50 larvae placed in garden soil and fresh sod	3	6

The data presented indicate that while the larvae may survive in the soil for a certain length of time without living roots upon which to feed, their presence is extremely important to the development of the grubs. This fact applies particularly to the summer, early autumn and spring, during which periods most of the feeding is done. This has also been borne out in our rearing cages where entire series have died for no apparent reason other than starvation when sod was not added to the soil.

SUMMARY

In the past it was generally believed that the larvae of *Popillia japonica* fed largely on decaying organic matter in the soil. Observations made during the season of 1921 indicate that during the spring and autumn, when most of the feeding is done, live plant tissues constitute between 60 and 70 per cent of the food of the grubs.

Injury has been noted to grass sod in pastures, golf courses, especially on the putting greens. In some places the grass was killed in patches. It is probable that the most serious injury to grass land will occur through the destruction of the finer rooted species, particularly blue grass and red top.

The larvae form cells in the soil and feed on the plant roots either at the bottom or top of the cell. The movements of the larvae in the soil tend to be vertical and most of the feeding is done between ½ inch and 3 inches below the surface.

The larvae are positively thigmotropic to roots, stones, sticks or to the bottom or sides of the breeding cages.

Analysis of the material found in the fore intestines of the larvae indicates that plant tissues constitute about 67.33 per cent by weight of the total material eaten. When this material was examined microscopically it was found to be composed of somewhat uniformly sized pieces of fresh plant tissue, pieces of decayed plants, and particles of soil. The fresh plant tissue, on the basis of the number of pieces, constituted 64.3 per cent of the aggregate.

Experiments conducted in the laboratory indicate that the mortality of the larvae is greatly increased when they are in soil or subsoil without access to living roots, compared with the mortality occurring when they are in a mixture of soil and fresh sod.

EULIA MARIANA FERNALD, A NEW APPLE FEEDER IN PENNSYLVANIA AND SOME RELATED FORMS ON APPLE

By S. W. FROST, *State College, Pennsylvania*

This species has not been found as abundant as the red banded leaf-roller, *Eulia velutinana* Walker which was previously referred to in the Jl. Econ. Ent. Vol. XIII 6, 1920. Although it is not as abundant it has been repeatedly collected, feeding both on the foliage and the fruit of the apple. An insect survey of Pennsylvania made during the summer of 1921 revealed the species in several different counties, indicating that it is well established in this state and that it has apparently become adapted to the apple. Engel[1] (1908) records it from New Brighton, Pa. He notes that it was rare at that time and found it at rest on trees in the forest. Fernald[2] (1882) records it from Maine, Massachusetts and New York as a feeder on Oak. It has also been recorded as a feeder on Blueberry, Vaccinium by Smith[3] (1910). The larvae resemble the red banded leaf-roller in appearance, being entirely yellowish green in color and about three quarters of an inch long when full grown. They are similar in habits, the majority winter as pupae and the adults issue in the spring, laying their eggs in masses on the trunks and larger branches of the trees.

Since the original note on *Eulia velutinana* Walker, as a pest of apple, it has been found that the species passes the winter as pupae and

not as adults and that there are three complete generations. The seriousness of this pest has been found considerably more than it was thought to be at first. It is now considered as one of the most important problems of the fruit growers of Pennsylvania, causing a considerable amount of scarring and side injury to the fruit. The life history of this species has been worked out in considerable detail and an extension circular from State College is in preparation and will be ready for release in a short time. Bull, 169 from the Penn. State College deals with this species as well as other leaf-rollers and bud-moths of the apple in Pennsylvania.

A third species of this genus *Eulia quadrifasciana* Fernald has been reported from New York state as a pest on apple but has not been found injurious in Pennsylvania. It has been recorded from Canada, Maine, New Hampshire, Massachusetts, New York, Pennsylvania and Delaware and no doubt has a general distribution throughout the North-Eastern part of the United States. As far as the writer is aware it feeds on apple alone.

It appears that the genus *Eulia* includes many injurious leaf-rollers of apple and that there may have been, in the past, some confusion of species. It is hoped that this note may be of value in calling to attention the various species working on apple and that more concentrated work may be conducted with these feeders. In Pennsylvania it is very evident that the genus *Eulia* includes the serious leaf-rollers and the marked difference in the life histories of these species make their control different from the control of the species of the genus *Cacoecia* which apparently are more injurious in New York state and portions of the country further North.

Thanks are due Mr. August Busck for the identification of these species.

1. ENGEL, HENRY. Annals Carnegie Museum, Vol. V No. 2 (1908).
2. FERNALD, C. H. Trans. Am. Ent. Soc. V (1882).
3. SMITH, J. B. Insects of New Jersey (1910).

Scientific Notes

The European Nitidulid beetle. *Heterostomus pulicarius* Linn., has caused considerable damage to strawberry plantations in Columbia County this season and is present in Saratoga, Albany, Niagara and Schoharie Counties in New York State. In 1921 Mr. H. Morrison collected specimens of this beetle on the grounds of the Arnold Arboretum near Boston. On May 2, 1921, a single specimen was collected at Milford, Conn., by Mr. M. P. Zappe. W. E. B.

The Anomalas collected at New Haven, Conn., in 1920, and again in 1921, have recently been identified as *Anomala orientalis* Water. This insect is a native of Japan and some ten years ago caused much damage to sugar cane in Hawaii, but parasites were introduced and proved successful in reducing the numbers of the

beetles below the destructive point. In Connecticut a few specimens only of this beetle were found on grass and weeds, on the edge of a nursery where new residences are being erected. W. E. B.

Feeding Punctures of Insects. At the meetings in Toronto, last year, I was asked the nature of the feeding puncture of the greenhouse whitefly (*Trialeurodes vaporariorum* West.) and was unable to give a definite statement regarding it. As stated at that time, the aphids in most cases select the soft bast of the vascular bundle. Allen has shown that the middle lamella consists really of two layers, one contributed by the secretion of each of the daughter protoplasts. The cell plate does not constitute the middle lamella but splits to form the plasma membranes of the daughter cells. It is along the cleavage plane of the middle lamella that the setal tract of the plant louse proceeds and along this tract the setal secretion is laid down. While the feeding does not, therefore, injure the mesophyll cells this secretion often has a distinct reaction, the cells becoming enlarged, oedematous and devoid of chloroplasts. The reaction of this secretion appears to vary with different species and different hosts. Hargraves has studied the punctures of the greenhouse whitefly and it seems evident that this insect selects similar tissues for feeding. *Trialeurodes vaporariorum*, then, should be grouped with the commoner aphids as to tissue selection and not with such forms as the red spiders which feed on the contents of the epidermal cells or a few cells immediately underlying them.

A. C. BAKER,
U. S. Bureau of Entomology

Sea Coast Flea Beetle (*Disonycha maritima* Mann.) **Injurious to Sugar Beets in Sacramento Valley, California.** While conducting investigations on the beet leafhopper (*Eutettix tenella* Baker) in the Sacramento Valley, Mr. G. Wright, formerly Agriculturist of the Alameda Sugar Company, and the writer visited some beet fields which were seriously injured by one of the Halticini, *Disonycha maritima* Mann. The foliage was riddled with holes and from 1-2 dozen beetles were found between the petioles at the crown of the beet or below lumps of soil near the beet root. The beetles also gnawed holes in the beet root. The pest was generally distributed over 157 acres of sugar beets near Knights Landing on May 27, 1919. The beet fields were visited again on June 16 and 22, but the beetles were rarely found. Trips were taken to the same fields in July and August but the beetles had disappeared. During 1920, the same beet fields were visited on May 26-27, with Mr. A. J. Basinger, formerly Entomologist of the Alameda Sugar Company, and the beetles were commonly taken but the injury was not so serious as during the preceding spring. During the summer, however, the beetles again disappeared. Although all beet centers were visited in the Sacramento Valley during the two seasons it was only in the Knights Landing beet district that this insect was found.

According to the literature nothing is known of the native food plants of this beetle. Mannerheim (Bul. der Naturforsch. Gesellsch. in Moscau, Bd. 16, p. 311, records the habitat in California on plants along the sea coast. Horn (Amer. Ent Soc. XIV, 1889, pp. 206-207) states that *D. maritima* occurs in California and Nevada Fall (Cal. Acad. Sci. VIII, 1901, p. 157) mentions one example taken at Pomona California in October. Van Dyke (Ent. News XXX, 1919, p. 244) found in the cleft of the rocks along the crest of the San Bruno hills which form the southern boundary of San Francisco County, fair assemblages of *D. maritima* during the winter.

Specimens were kindly determined for me by Professor E. C. Van Dyke.

HENRY H. P. SEVERIN, Ph.D.
Calif. Agr. Exp. Sta.

The Distribution of the Pink Bollworm of Cotton, *Pectinophora gossypiella* **Saunders, in Porto Rico.** In July, 1921, Mr. Ignacio L. Torres, a Sub-Inspector of Agriculture, found a caterpillar injuring cotton bolls in plants at Humacao, Porto Rico, which on examination proved to be the pink bollworm, *Pectinophora gossypiella* Saunders, and soon after the pest was found thruout the commercial cotton growing section of the island. A careful survey of the distribution of this insect was made during the past winter and spring (1922) by Mr. J. D. More, formerly of the pink bollworm eradication force of the Federal Horticultural Board, and the writer.

Cotton plants or trees often occur along roads and in the yards about houses in most parts of Porto Rico, but are sometimes quite rare, especially in the coffee-growing mountainous districts of the interior. On such semi-domestic plants, the pink bollworm occurs all around the island near the coast, except around Mayaguez on the west, but it has not been found in the interior even a few miles from the ocean. It was not found on plants collected at the following places: Rio Piedras, Carolina, Canovanas, Rio Grande, Mameyes, Guaynabo, la Muda, Caguas, Cayey,

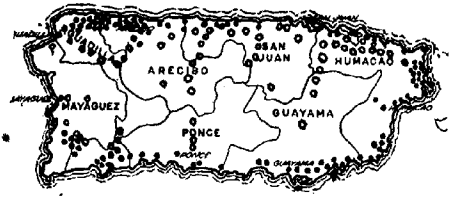

Fig. 16.—Map of Porto Rico, showing Distribution of the Pink Bollworm of Cotton, *Pectinophora gossypiella* Saunders, in the Spring of 1922, as determined by J. D. More and George N. Wolcott. Black dots indicate infested plants, circles uninfested plants.

Comerio, Bayamon Plantaje (Point Salinas), Toa Alta, Vega Alta, Manati, Ciales, Villalba, Garrochales, Utuado, Adjuntas, 14 km. north of Yauco, Lares, San Sebastian, Maricao, Mayaguez (Cerro de las Mesas), and Hormigueros. It is present thruout the commercial cotton growing region, Aguadilla to Arecibo, and has spread further into the interior here, to Moca on the west and to Bayaney on the east (15 km. from the coast) than anywhere else.

The most heavily infested plants seen were on the beach south of Maunabo, in the southeastern part of the island, and it appears possible that its presence on the east and southeast coast represents a separate infestation, either from moths blown from adjacent islands, or seed washed ashore. It is supposed that the pink bollworm was brought to Porto Rico in infested seed from St. Croix before its presence had been reported from that island, and thus established in commercial plantings at Sabana Grande (Lajas), Aguadilla to Arecibo, at the Laguna de Tiburones near Vega Baja, and on plants near the gin at Martin Peña. The infestation eastward along the coast to Point Cangrejos and Loiza can be traced to seed brought from the gin, as most of the plants here are uninfested. The next infestation to the east is on the beach between Mameyes and Luquillo, and altho in the hills between Luquillo and Fajardo the cotton is uninfested, approaching Fajardo and extending along the east and south coast as far as Yauco, practically every plant is infested. On the west coast, some of the plants around San German and Cabo Rojo were infested

and north of Añasco and at Coloso the infestation is light or doubtful, the interior of some of the bolls being characteristically stained, but no insects found. On the north coast outside of the cotton district, infested plants have been found at Barceloneta, Vega Baja and on the beach at Dorado, The pink bollworm has also been found in Vieques Island to the east of Porto Rico and in Mona Island to the west. GEORGE N. WOLCOTT

The Use of Poisons as Insecticides in The French Colonies. In an article in the *Comptes Rendus des Séances de l'Academie d'Agriculture de France* for the 29th of March, 1922, Veterinary Major H. Velu gives a very interesting statement of French laws which have operated to prevent the use of arsenical poisons, not only in France, but in her colonies. He shows that the use of these poisonous substances has given rise to no fatal accidents in America, and that the experiments made by the New Hampshire station from 1912 to 1916 have irrefutably established the fact that the dangers of the use of such poisons are greatly exaggaerated. He cites the use of arsenical baths against the Texas fever tick in the United States, and gives figures showing that in 1919 250,196 gallons of arsenical solutions were used, in which 48,530,229 domestic animals were bathed. He states that by the use of arsenious acid and its derivatives, soluble or insoluble, immense regions in California, previously deserted, have been transformed into productive country. Thanks to arsenicals, he says, California inundates all the markets of the world with its fruits; and, thanks to the arsenicals, English—and Spanish—speaking countries produce cattle of the first quality. He shows that the French are away behind and that the French colonists are ignorant, as a rule, of spray formulas and animal bath formulas. He states that it is quite evident that fruit orchards cannot be developed in North Africa unless they can be easily protected against injurious insects; and that high grade domestic animals cannot be raised without arsenical baths. He shows that the employment of arsenicals in agriculture in France is regulated by the law of the 12th of July, 1916, a revision of the law of 1845, by the decree of the 14th of September, 1916, and the Ministerial Circulars of the 14th of January, 1917, and the 27th of April, 1921. These laws allow the sale and the employment of insoluble arsenical compounds exclusively for the struggle against the parasitic diseases of plants. Contrary to the English law entitled "The Poisons and Pharmacy Act" of 1908 and the modifying texts, they do not apply in any case to soluble compounds however indispensable for use against the parasites of domestic animals. They tolerate in a provisional way the use of soluble arsenicals in agriculture since the spring of 1922. He shows that in June, 1921, the Academy of Medicine opened the question once more and Professor Cazeneuve argued again against the free use of arsenicals in agriculture.

He shows that in France the economic side of the question is possibly secondary or even negligible, but it is quite different in the colonies, where the prohibition of arsenicals, and even soluble arsenicals, will bring disaster and will greatly reduce the value of the products of the colonies.

The French laws are applicable to Algeria, to the colonies and to the countries of the protectorate. This puts the French colonies at a great disadvantage with the English colonies and the Americans, who, with their essentially practical spirit, have not hesitated to permit arsenical baths and all of the arsenical sprays whether soluble or not; and the French rules are anti-economic and indeed superannuated.

"Summing up," he says, "the question resolves itself down to whether a few accidents which have happened in France owing to the employment of arsenicals are sufficiently important to justify in the colonies the depreciation of extremely fertile

regions, the abandonment of fruit culture and stock raising, by the absolute or relative prohibition of methods judged by the whole world to be indispensable to agriculture, horticulture and stock raising, awaiting the day when modern biological methods will give us the beautiful results which we have a right to hope for, notably by the destruction of plant enemies through the help of beneficial exotic insects and the suppression of piroplasmoses by vaccination." L. O. H.

American Foul Brood. To transfer bees from infected hive to clean hive by the smoke method. Prepare a clean hive body with full sheets foundation. Place on this hive body a ventilated inner cover which may be made by cutting out about one-third of the solid cover or bee escape board and tacking wire screen over the opening to make it bee-tight.

When ready to transfer bees from infected brood chamber to clean hive body in new brood chamber, which should be done during a honey flow, go to the infected colony sometime during the middle of the day when bees are working in the fields and remove the queen. Place her in a cage with a little candy and take care of her until ready to return her to the bees in the afternoon.

About sundown take your clean hive body and go to the infected colony. Remove the inner cover from the infected colony and place the clean hive body with full sheets of foundation and ventilated cover on top of the infected colony. Reduce the entrance to the infected colony to about ⅜ inch x 2 inches or 3 inches. Have your smoker well filled and giving a good dense cool smoke. Smoke the bees gently through the entrance to the old brood chamber, being careful not to use too much smoke or work the smoker hard or fast enough to make the smoke hot—dense cool smoke applied almost continuously gives the best results. The ventilated inner cover on the clean hive body on top of the old brood chamber will allow the smoke to escape and the bees not being able to escape at the entrance will leave the combs in the old brood chamber and attempt to escape at the top of the clean hive body. By smoking gently for ten or fifteen minutes almost all the bees will desert the old brood chamber and cluster on the frames, top and sides of the clean hive body. You can tell pretty well when all the bees are out of the old brood chamber by looking into the clean hive body through the wire screen cover. When you are quite sure the bees are all out of the old brood chamber close the entrance and set it, with the clean hive body still on top, to one side and place clean bottom board on the old stand. Now gently lift the clean hive body, bees and all, off the old brood chamber and place it on the clean bottom board on the old stand. If any bees are left on top of the frames of the old brood chamber after removing the clean hive body they may be brushed off and placed in front of the new brood chamber. Replace the cover and the old brood chamber, closing it up bee-tight. By this time the bees in the clean hive body, which is now your new brood chamber on the old stand, will have quieted down so that you may give them back their queen which you have in the cage. This should be done by removing the stopper from the cage so the queen can escape and pushing the inner cover over just enough to lay the cage on top the frames. If the bees are still clustered on top the frames so as to make it impossible to move the cover far enough to permit placing the cage on top the frames without allowing bees to escape, push the open cage in under the frames at the entrance, but you should watch the entrance for four or five minutes to see that the queen does not come out as it sometimes happens that the queen not finding any bees on the bottom board and feeling that she is in a strange place runs out at the entrance and gets lost.

If you have only one infected colony to treat you cannot very well save the healthy brood in the old brood chamber which you left closed up beside the clean hive body

or new brood chamber on the old stand. Then take it into the house at once and cut out the old combs and render them into wax as soon as possible so as to get rid of any possibility of infection from that source. Any bees found in the old brood chamber when opened in the house should be destroyed. Do not allow a single bee to escape as it might carry infection to another colony or to its own colony if the bees had cells drawn out enough for storing honey.

If you have two infected colonies to treat, transfer the stronger first and place the old brood chamber over queen excluder on the weaker one. Three weeks later remove the queen excluder and put a bee escape in its place. When the old brood chamber is clear of bees, remove it, close it up bee-tight and put it in the house Then transfer the second colony to a clean hive body in the same manner as the first and close up the old brood chamber and put it in the house. Then cut out and render all combs into wax at the same time. Do not let any bees from these old brood chambers escape to return to the hives.

If you have several colonies to be treated you may use two or three of the weaker ones to stack up the brood chambers from treated colonies to save the healthy brood and strengthen the weaker ones. The old brood chambers from infected colonies may be placed on these weaker colonies over queen excluder as they are taken away from the treated colonies, stacking them up four or five stories high Three weeks after the last brood chamber was put on one of these colonies, the old brood chambers may be removed one at a time by the use of a bee escape until the colony is reduced to one brood chamber, and then bees transferred into clean hive body as described.

If any of the "stackup" colonies have more bees than one brood chamber will hold when taking off the old brood chamber, it will facilitate the work to put on empty super between the brood chamber of the "stackup" colony and the last of the old brood chambers to be removed to give clustering space for the bees. Put bee escape over the empty super and next to the old brood chamber to be removed. This empty super should not be allowed to remain on more than a day or two or the bees will build comb in it. If ready to transfer the bees to a clean hive body as soon as the last of the old brood chamber has been removed, which is the best time to do so, set the super with bees clustered in it to one side until you have transferred the bees from the old brood chamber to the clean hive body, then the bees in the empty super may be dumped in front of the clean hive body on the old stand and they will run in.

All the old brood chambers are taken into the house and combs cut out and rendered into wax and the hive bodies, bottom boards, inner covers, treated by burning out and the frames boiled in strong lye water to clean and destroy germs before using again.

This method of transferring bees from infected brood chamber to clean hive makes use of the same principles as are used in shaking or brushing bees from the combs, but is free from the greatest objections raised to shaking or brushing. The principal advantage of the smoke method is that the transfer of the bees is made without fuss or mess—no infected combs exposed at any time—no honey scattered around to be gathered up by bees—no demoralized bees scattered around to get lost and possibly enter the wrong hive carrying the disease.

If the work is done carefully, as it should be done, there will be no bees outside the hive at any time, except a very few on the outside of the clean hive when it is removed from the old brood chamber and placed on the clean bottom board. These may be brushed off and placed at the entrance and they will go in the clean hive.

W. L. WALLING
Hardin, Montana

JOURNAL OF ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

AUGUST, 1922

The editors will thankfully receive news matter and other items likely to be of interest to our readers. Papers will be published as far as possible in the order of reception, except that papers of reasonable length may be accepted in the discretion of the editor for early publication, provided that at least 100 reprints be ordered at full price rates; in the case of other matter, the maximum of 2,500 words is still operative. Photo-engravings may be obtained by authors at cost.

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Have we reached the limit in methods of poisoning forest trees for protection against leaf eating caterpillars? This question has been raised by the remarkably successful results of last season in poisoning the catalpa sphinx in Ohio and the fact that aeroplane dusting is being tested in New Hampshire for the control of the Gipsy Moth. Those familiar with the early work against this latter insect will recall the hand and low powered equipment used at that time and the manifest disproportion between the apparatus and the size of the undertaking. Long strides have been made since those days and the present high pressure outfits with long lines of hose have greatly increased the range and efficiency of such treatment. There are obvious limitations even to these methods. It has been felt in the past that direct remedial measures were impracticable under forest conditions and such may always prove to be the case excepting, possibly in areas where there are unusually high values, as for example within relatively short distances of great centers of population. On the other hand, it is becoming increasingly apparent that forests must be better protected or there will in the near future be a dearth of wood and wood products, not to mention the part these growths play in modifying stream flow and tempering climatic conditions. There is a possibility of the economic entomologist invading the air and working out a practical method of checking by artificial means unusual outbreaks of leaf feeders, possibly native as well as introduced. Wide spread depredations of this character, it is generally conceded, result from a disturbance of natural relations and if this is the case, it does not seem unreasonable to believe that a moderate to somewhat thorough checking of the outbreak at its center would result in reducing the pests to such an extent that natural agencies would take care of the remainder. In other words, a somewhat superficial and from

an orchardist's standpoint unsatisfactory type of poisoning may give all the protection needed in wild areas and if this should prove to be the case and could be clearly established, it might be entirely practicable to provide for a system of artificial checks which would do much toward maintaining a normal relationship between insect and plant life. The aeroplane with its distribution of the dust from above affords a ready means of placing the poison on parts of trees preferred by a number of destructive leaf feeders. The possibilities of any such method can be determined only by large scale work with a number of species and with this in mind we endorse the work in New England and express the hope that it is only the beginning of a serious attempt to determine possibilities along these lines.

The apple red bug (*Heterocordylus malinus* Reut.) whose distribution has been generally known as the northeastern states is quite common in various parts of Iowa and has been reared from Crataegus and apple at Ames this year. There are specimens in the Iowa State College collection taken at Ames as early as 1897, twelve years before the species was described by Reuter from New York. The writer's observations in Iowa as well as in New York indicate that Crataegus is the preferred host and probably the original food plant of this species.

WALTER H. WELLHOUSE

Infective Beet Leafhoppers (*Eutettix tenella* Baker) **do not Transmit Curly Leaf Daily.**—An infective beet leafhopper which completed all of the nymphal instars on a blighted beet does not transmit curly leaf daily. Three infective males, bred from eggs deposited by infective adults, passed through the last moult on July 30, 1919 and were confined in three cages. In the first cage a male was provided with a healthy beet daily; in the next experiment a healthy beet was put in the cage with the hopper at the end of every second day, and in the last experiment another male was allowed to feed, alternating daily, on a curly leaf and healthy beet. The work was conducted out-of-doors at Manteca situated in the northern part of the San Joaquin Valley. Five sugar beets developed curly leaf of 49 beets used in the experiment.

In the next experiment 1, 2, 3, 4 and 5 infective males which completed all of the nymphal stages on a blighted beet were confined in five cages in the greenhouse at Berkeley. A healthy beet was placed in each cage daily. When a leafhopper died, another was put into the cage, except in the one containing a single specimen. The experiment extended over a period of 54 days from November 1-December 24, 1920 and was discontinued when the single male died. The results follow:

One infective male transmitted curly leaf to 3 beets (5.5%) in 54 days.
Two infective males transmitted curly leaf to 10 beets (18.5%) in 54 days.
Three infective males transmitted curly leaf to 31 beets (57.4%) in 54 days.
Four infective males transmitted curly leaf to 28 beets (51.8%) in 54 days.
Five infective males transmitted curly leaf to 34 beets (62.9%) in 54 days.
Mean maximum 78.9 F., mean minimum 61.7 F., mean 70.3 F. temperatures.

HENRY H. P. SEVERIN, Ph.D
Calif. Agr. Exp. Sta.

Current Notes

Mr. Paul M. Gilmer has been appointed assistant in entomology and economic zoology at the University of Minnesota.

Prof. E. W. Stafford of the Mississippi Agricultural College is teaching entomology at Purdue University during the present summer season.

According to *Science*, Oberlin College conferred the honorary degree of doctor of science on Dr. Vernon L. Kellogg on June 21.

According to *Science*, Dr. R. P. Bigelow has been promoted to the professorship of zoology and parasitology at the Massachusetts Institute of Technology.

According to *Experiment Station Record*, Mr. John H. Harman has been appointed extension specialist in entomology at the Michigan College and Station.

According to *Experiment Station Record*, Mr. Clarence E. Mickel has been appointed assistant in economic entomology at the Minnesota University and Station.

Mr. W. V. Balduf of the Ohio Agricultural Experiment Station, Wooster, Ohio, has been appointed assistant professor of entomology at the University of Illinois.

The following temporary appointments have been made in the Bureau of Entomology: W. D. Mecum, Madison, Wis; J. M. Reilly, Kingsville, Tex; H. L. Weatherby, Birmingham, Ala.

An extension has been made this summer to the Aylmer, Quebec, laboratory, Division of Forest Insects, in order to carry on additional biological studies.

Miss Mabel Colcord, Librarian of the Bureau of Entomology, attended the annual meeting of the American Library Association at Detroit and Ann Arbor, Mich., June 26.

Prof. John J. Davis, Lafayette, Ind., visited Washington, D. C., the first week in aJune to confer with officils of the Bureau of Entomology on insect problems of inter, state interest.

Mr. W. S. Abbott, who is in charge of the Insecticide Testing Station at Vienna, Va. will speak before the Insecticide and Disinfectant Manufacturers' Association in Chicago, June 12-13.

According to *Science*, Dr. Vernon L. Kellogg, permanent Secretary of the National Research Council, gave the annual Phi Beta Kappa address at the University of Virginia on June 13.

Mr. H. R. Painter of the Bureau of Entomology visited the Ohio Station recently in connection with making records on the date of seeding wheat plots on the severa district and county farms.

Science records the death of Dr. Alfred G. Mayer, director of the department of marine biology of the Carnegie Institution. Dr. Mayer died June 25, at Key West, Fla., aged fifty-four years.

Mr. A. F. Burgess visited New Haven on June 5 for a conference over extending the gipsy moth quarantine on account of the additional territory found infested by the scouting operations of the past winter.

The Mexican bean beetle is doing considerable injury in many sections of Tennessee, it being present in some 36 counties, with damaging infestations

Dr. E. D. Ball, Director of Scientific Research, U. S. Department of Entomology, was scheduled to speak at the Ohio Agricultural Experiment Station, Wooster, Ohio, June 22, on "The Place of Agricultural Research in National Development."

According to *Experiment Station Record*, a new quarterly entomological journal will be published at Helsingfors, Finland, under the name of *Notulae Entomologicae*. The initial number has just appeared, and contains several original articles, abstracts and necrological notes.

According to *Science*, Prof. J. G. Needham, head of the department of biology and entomology in Cornell University, is to exchange for the next college year with Dr. William A. Hilton, of the department of zoology, Pomona College, Claremont, California.

The Bureau chiefs gave a luncheon at the Cosmos Club, Washington, D. C., May 11, in honor of the fifty-sixth birthday of Secretary Wallace. Entomologists present were Drs. E. D. Ball, L. O. Howard and C. L. Marlatt. Dr. Howard acted as toastmaster.

Dr. J. K. Haywood, Chairman of the Insecticide and Fungicide Board was scheduled to address the Disinfectant Manufacturers' Association at Chicago, June 12 and 13, on "The Work of the Bureau of Entomology in Connection with the Enforcement of the Insecticide Act."

According to *Science*, Dr. C. P. Gillette, director of the Colorado Agricultural Experiment Station, delivered at the Denver Public Library on June 6, a lecture on "Heredity and the Improvement of Man" under the auspices of the Genetic Foundation of Colorado.

The following transfers are announced in the Bureau of Entomology: B. L. Boyden, sweet-potato weevil eradication, from Daytona to Tampa, Fla; W. H. Merrill, MacCleney to Tampa, Fla; E. R. Barber, southern field crop investigations to tropical and sub-tropical fruit insect investigations, effective June 1.

According to *Science*, Mr. Hugh C. Huckett, a graduate student at Cornell University, has been appointed entomologist for the newly-established laboratory for the study of vegetable crop pests on Long Island, to be maintained from State funds under the joint direction of the State Agricultural Experiment Station and the State College of Agriculture.

Mr. G. M. Stirrett, who recently graduated from the Ontario Agricultural College, has accepted a position with the Purdue Experiment Station for the summer, and this fall at the beginning of the school term, will become associated with the Department of Entomology, Purdue University, as graduate assistant.

Mr. C. M. Smith, assistant chemist, has been detailed for several months to the Bureau of Entomology laboratory, Tallulah, La., to study the chemical and physical properties of calcium arsenate used in the control of the cotton boll weevil, with the idea of developing a more satisfactory product.

Mr. G. F. Moznette of the Bureau of Entomology, who is located at Miami, Fla., has recently been elected an honorary member of the California Avocado Association, in recognition of the service he has rendered the industry in the United States by his work with the insect enemies of the avocado.

Mr. J. C. M. Gardner, Rhodes Research Scholar, who is proceeding to India to join the Indian Forest Service, is spending several days at headquarters. He has been visiting various entomological centres in the United States, and before coming to Ottawa, spent some time with Mr. R. Hopping, in charge of our Forest Insect work in Bristish Columbia.

According to *Science*, the University of Maryland at its commencement on June 10, conferred the honorary degree of doctor of science upon Eugene Amandus Schwarz, honorary custodian of Coleoptera in the U. S. National Museum. Dr. Schwarz began official work as a specialist in Coleoptera for the Division of Entomology under the U. S. Commissioner of Agriculture in 1878.

Mr. William Moore of the Japanese beetle laboratory at Riverton, N. J., spent a week in Birmingham, Ala., going over insecticide tests with N.F. Howard. A large series of new combinations is being tested at the present time, in addition to the standard series of arsenicals which Mr. Howard is now testing, both for insecticide injury and insect control.

According to *Science* the gold medal of the Linnaean Society of London, which is given in alternative years to a botanist and a zoologist, was this year awarded to Prof. E. B. Poulton, at the anniversary meeting on May 24. In making the presentation, the President, Dr. A. Smith Woodward, referred to Prof. Poulton's long labors in entomology, and his keepership of the Hope Collection at Oxford.

Mr. R. H. Van Zwaluwenburg, formerly of the Bureau of Entomology and now entomologist of the United Sugar Companies of Los Mochis, Sinaloa, Mexico, has gone to Cuba to collect specimens of the tachinid parasite of the sugar-cane moth borer for introduction into Mexico. This parasite has already been introduced into Louisiana by the Bureau. Mr. Van Zwaluwenburg is co-operating with the sugar-cane insect laboratory at New Orleans.

According to *Experiment Station Record*, the New York State legislature made an appropriation for the purpose of studying the problems of truck crop growers on Long Island, the work to be under the joint direction of the State Station at Geneva and the New York State College of Agriculture. The act carries an appropriation of $45,840 to provide for the purchase of a tract of land, the erection of a greenhouse, the purchase of equipment and the employment of an entomologist and a plant pathologist to be permanently located at the Station.

Dr. Charles P. Alexander, of Urbana, Ill. has been elected assistant professor of entomology at the Massachusetts Agricultural College, to fill the vacancy caused by the resignation last year of Dr. W. S. Regan, who was called to Montana. Dr. Alexander is a graduate of Cornell University and since graduation, he has taught at Cornell, the University of Kansas and the University of Illinois. For two years he had charge of the insect collections at the University of Kansas, and for the past three years has been connected with the Illinois State Natural History Survey, and has had charge of the insect collections. Dr. Alexander has specialized in systematic entomology, particularly in the dipterous family Tipulidae. He will assume his new duties next September.

Mr. Arthur Gibson, Dominion Entomologist of Canada, spent April 21 to 24 inclusive, in Washington, D. C. On April 23d he attended a meeting of representatives of biological societies called by the United States National Research Council. On April 24th, by invitation of Dr. Howard, he attended the first session of the

National Academy of Science at which Dr. Howard presented a paper relating to some recent work of the United States Bureau of Entomology in importing parasites of injurious insects. The balance of the time at Washington was spent in conference with various members of the Bureau. On April 25th, Mr. Gibson spent the day in the neighborhood of New York in company with Mr. Shaw who is in charge of the United States Federal Horticultural Board work at that port. The vacuum sterilizing plant at Brooklyn and the vacuum fumigation plant at Staten Island were visited. April 27th was spent with Dr. T. J. Headlee, State Entomologist of New Jersey. In the morning in company with Messrs. MacIntyre and Weiss, a visit was made to the gipsy moth infestation and in the afternoon certain phases of the New Jersey mosquito work were examined.

We learn from *Nature* that a prize of $5,000 is offered by Mr. Frank J. D. Barnjum of Montreal for a practical method of combating and suppressing the spruce bud worm, bark beetle and borer, which have caused such tremendous damage in the forests of Eastern Canada and the United States. The Province of Quebec alone has suffered a loss during the past ten years of 150,000,000 cords of standing pulpwood by these pests, which represents a market value in pulpwood of three billion dollars, or if manufactured into paper, of seven billion dollars. This represents a loss of wood sufficient for forty-five years' requirements for newsprint for the North American continent. The competition closed on August 1, and the $5,000 will be given for the successful suggestion that is accepted by the judges, who will be Sir William Price of Messrs. Price Bros., Quebec; Dr. C. D. Howe, dean of the faculty of forestry, Toronto University; Mr. Fred A. Gilbert, Great Northern Paper Company, Bangor, Maine; Mr. G. C. Piche, chief of forest service, Quebec, and Mr. Ellwood Wilson, Laurentide Company, Grand Mere, Quebec. Competitive suggestion, should reach Mr. Frank J. D. Barnjum, New Birks Building, Montreal, Canada, before August 1.

Announcement has been made of the following appointments in the Entomological Branch, Canadian Department of Agriculture. Mr A. Kelsall, Assistant Entomologist, has been promoted to the rank of Entomologist to replace Mr. George Sanders who recently resigned from this post. He will be in charge of the Insecticide Investigations now being conducted at the Annapolis Royal laboratory. Messrs. H. H. Thomas and Norman Cutler have been appointed as Junior Entomologists and will assist Mr. Hopping in the pine bark beetle control work in British Columbia. Mr. A. W. MacKenzie and Mr. R. E. Balch have been appointed as Temporary Investigators of insect Pests. Mr. MacKenzie will assist Mr. Dunn in New Brunswick and Mr. Balch will be stationed for the present at the Aylmer, Que., forest insect station to assist Mr. Hutchings. Messrs. Dunn and Fleming are now in northern New Brunswick studying budworm injury to red spruce in that region. Mr. R. S. Hawkins has been attached to the Fredericton laboratory as Insect Pest Investigator and will assist Dr. Tothill in natural control studies of the tent caterpillars, etc. Mr. A. B. MacAndrews has also been attached to the same laboratory as Insect Pest Investigator and will assist Mr. A. B. Baird on natural control studies of the larch sawfly, larch case-bearer, etc. Messrs. A. Fowler, C. S. Thompson and W. L. Oliver, have been attached as Investigators of Insect Pests, to the Port Stanley laboratory in connection with Corn Borer Quarantine work. Temporary appointments for the summer: Mr. Walter Carter, Junior Entomologist, at Lethbridge, Alta; Mr. George Hammond, Insect Pest Investigator at Ottawa. He recently received his B.S.A. degree from McDonald College; Mr. A. A. Wood, Insect Pest

Investigator at Strathroy, Ont.; Mr. R. H. Painter, Junior Entomologist, at Port Stanley, Ont.; Mr. H. E. Gray, Junior Entomologist, at Lethbridge, Alta.; Mr. A. Robertson, Junior Entomologist, at Treesbank, Man.; Mr. R. M. White, Junior Entomologist, at Treesbank, Man. Mr. J. N. Knull, of the Pennsylvania Department of Agriculture, Harrisburg, Pa., has been appointed as a temporary Entomologist for the summer and will assist Dr. Craighead in the spruce budworm investigations. Mr. Knull reported for duty on May 29th and accompanied Dr. Craighead on his recent trip to Long Lake, Que. Mr. C. B. Garrett appointed temporarily as an Insect Pest Investigator is making collections, etc., in the Banff district. Mr. L. M. How, appointed temporarily as an Insect Pest Investigator, reported for duty on May 11th.

The American Association for the Advancement of Science, Pacific Division meeting at Salt Lake City was attended by quite a number of Entomologists. Saturday, June 24th, the Entomologists, Pathologists, Ecologists and members of the Society of Western Naturalists made an excursion up Parley's Canyon to study notable formations and the peculiar flora and fauna. About fifty persons made the trip. Among the persons attending this excursion were: Professor E. V. Gautier, of the University of Algiers; Dr J. P. Lotsy, of the University of Leyden; Professor F.B. Sumner, of Scripps Institute for Biological Research; Dr. David Starr Jordan, of Stanford University; Dr. Barton W. Evermann, California Academy of Sciences; Professor G. B. Rigg, University of Washington; Dr. W. L. Tower, American Hospital, Tampico, Mexico; E. P. Van Duzee and wife, California Academy of Sciences; Mr. R. E. Campbell and wife, Bureau of Entomology, Alhambra, California; A. O. Larsen, Bureau of Entomology, Alhambra, California; Professor Hazel Field, Mac Coun College, New Oleans, La.; A. R. C. Haas, Citrus Experiment Station Riverside, California; Professor G. W. Hungerford, University of Idaho; J. M. Reeder, University of Idaho; Dr. A. L. Lovett, Oregon Agricultural College; F. S. Baker, Forest Service, Ogden, Utah; H. S. Reed, Citrus Experiment Station, Riverside, California; Dr. I. M. Hawley, and Dr. B. L. Richards, Utah Agricultural College, Logan, Utah; Professor H. R. Hagan, and Professor Pansy Evans, University of Utah; Professor A. O. Garrett, Salt Lake City High Schools, George I. Reeves, Bureau of Entomology, Salt Lake City; G. G. Thorne, Bureau of Plant Industry, Salt Lake City; Dr. E. G. Titus, Utah-Idaho Sugar Company, Salt Lake City; and a number of others.

Horticultural Inspection Notes

Messrs. J. Leslie Rogers and Frank D. Luddington have been given temporary employment at the Connecticut Station in nursery inspection work.

The brown-tail moth work in Nova Scotia was completed on March 31, a total of 979 nests were collected during the winter as compared with 530 collected during the preceding year.

Inspectors of the Federal Horticultural Board on the Mexican Border have been kept busy intercepting, in co-operation with Customs officials, contraband plant material. To illustrate—during the fiscal year of 1921 and 1922, 19,773 avocados were intercepted.

Professor R. Kent Beattie of the Federal Horticultural Board attended the meeting of the American Association of Nurserymen in Detroit from June 28 to 30, and gave an address on "Protecting American Nurserymen Against Foreign Plant Pests."

Dr. C. L. Marlatt, Chairman, and Messrs. K. F. Kellermann and G. B. Sudworth, members, of the Federal Horticultural Board, attended the interesting conference on horticultural and plant quarantine matters held at Sacramento, Cal., from May 29 to June 3, 1922.

In Connecticut the State gipsy moth quarantine has been extended to coincide with the Federal quarantine which became effective July 1st. The State quarantine takes effect July 20, and is Quarantine Order No. 4.

Messrs. A. F. Burgess and D. M. Rogers of the Bureau of Entomology were present and explained the working of the Federal quarantine at a hearing in Hartford July 6, to extend the Connecticut State quarantine because of the gipsy moth.

To illustrate some of the disagreeable duties of an inspector performing his official work at a port of entry—the inspectors of the Florida State Plant Board were recently forced to have removed several wreaths which arrived from Havana on a casket. On dissecting the floral pieces, leaves were found infested with egg spirals and pupae of the black fly.

On June 12, a vessel containing 808 bags of cotton seed arrived in New York from Porto Rico for trans-shipment and immediate export to Scotland. This seed was unladen upon a lighter under the supervision of Inspector R. G. Cogswell who made a careful examination of some of the seed and found it to be infested with the larvae of the pink bollworm.

Mr. George Makinson reported for duty as inspector on the apple sucker quarantine on April 3d. Mr. Makinson will be stationed at Wolfville, Nova Scotia. Mr. Wilfred Ryan reported for duty on April 15th at Toronto. Mr. Ryan assisted in the inspection of nursery stock and will be transferred later to the corn borer work. Mr. Arthur Finnamore has been assisting in inspection work at Toronto since early in April. Mr. N. A. Patterson has been attached to the staff at Annapolis Royal in the capacity of Inspector of Insect Pests.

On April 21, 1922, the Destructive Insect and Pest Act Advisory Board of Canada was constituted by Order-in-Council. The present members are: Mr. Arthur Gibson, Dominion Entomologist, Chairman; Mr. E. S. Archibald, Director of the Experimental Farms, Vice-Chairman; Dr. J. H. Grisdale, Deputy Minister of Agriculture, Mr. H. T. Gussow, Dominion Botanist; and Mr. L. S. McLaine, Chief, Division of Foreign Pests Suppression, Secretary. The Board will supervise the carrying out of the regulations under the Destructive Insect and Pest Act, and will also recommend from time to time such changes or additions to the regulations as may be deemed necessary.

The work of the inspectors of the Federal Horticultural Board on the Mexican Border has been considerably reduced as a result of the heavy rains during the month of June. The movement of traffic between the ports of Del Rio, Eagle Pass, and Laredo, and the corresponding Mexican towns was discontinued for a few days. Both the railroad and foot bridges at Eagle Pass were carried away by the rain, and as a result, railroad traffic has been stopped at that port. The National Lines of Mexico were cut, and there will probably be no cars for examination in Matamoras for a month or more.

Pacific Slope Notes

Dr. E. P. Van Duzee, who has been collecting in Utah, visited the Agricultural College at Logan and took part in a trip to White Pine Lake.

Mr. George E. King, formerly Assistant Entomologist of the Utah Agricultural Experiment Station, has entered the University of Illinois. Mr. King will assist in apiculture and do graduate work.

Mr. Justus Stevens is acting as field assistant in Entomology at the Utah Agricultural College. Mr. Stevens will take the place of Mr. George E. King who has entered the University of Illinois.

Dr. James G. Needham of Cornell University gave a series of three lectures to summer school students of the Utah Agricultural College. Dr. Needham was the guest of Dr. I. M. Hawley, head of the Department of Zoology and Entomology of the Agricultural College. Collecting trips were taken to White Pine Lake, Logan Canyon, and Franklin, Idaho. On the last named trip a serious outbreak of the "Mormon cricket" (*Anabrus simplex*) was visited.

Prof. Ralph H. Smith, formerly entomologist of the Idaho Station and now with the California Central Creameries Co., with headquaters at San Francisco, Cal., has traveled for six weeks through the Eastern States, visiting most of the Agricultural Experiment Stations. He was at New Haven, Conn., on June 16th, and demonstrated the use of casein spreaders in spray mixtures.

A change in the personnel of the entomological staff of the University of Idaho and in the plan of organization has recently been made. With the resignation of Mr. Ralph H. Smith, Mr. Claude Wakeland has been appointed Experiment Station Entomologist and has been succeeded by Mr. Don B. Whelan as Extension Entomologist. Mr. Whelan received his graduate training at Kansas State Agricultural College and at Ohio State University. He was Extension Entomologist for Michigan for three years, resigning to accept a position with the Dow Chemical Co. After a year in commercial work he entered business on his own account in Michigan, but has returned to professional work because of the greater interest it holds for him. Under the reorganized plan of work, experimental and extension entomology will be conducted with very close co-operation, since both phases of work are under the supervision of the Station Entomologist. The outstanding extension problem for the season is spraying for control of alfalfa weevil, and the main experimental problems are control of elcodes beetles attacking grain crops and control of alfalfa weevil by dusting.

Apicultural Notes

The Connecticut Beekeepers Association held one of its summer field meetings, Saturday, June 24, at the home of Miss Caroline Baldwin, New Haven.

Mr. George E. King, formerly of the Agricultural Experiment Station, Logan, Utah, is now in charge of Apiculture at the University of Illinois, Urbana, Ill.

The Maryland State Beekeepers' Association held a meeting at the Bee-Culture Laboratory on June 29th. This Association has paid a visit to the Laboratory for the past several summers.

Mr. R. B. Willson, formerly extension specialist in beekeeping in Mississippi, has been transferred to Cornell University where he will continue the extension work carried on formerly by Mr. George H. Rea.

The annual beekeepers' Chautauqua held by the University of Wisconsin will be held at Green Bay, Wisconsin, the week beginning August 7th. E. F. Phillips, E. R. Root, George S. Demuth, S. B. Fracker, H. F. Wilson and C. P. Dadant are expected to attend and take part.

On August 21 and 22 there will be meetings in Tennessee arranged for the Southern itinerary of beekeepers. On the 21st the meeting will be held at Clinton, Tennessee, and the members of the East Tennessee Beekeepers' Association will be present. On the 22 the meeting will be held in the queen rearing yard of John M. Davis of Springhill, Tennessee, and the members of the Tennessee Beekeepers' Association will be present. The program for these meetings is being made out at this time. Honey production in the State is considerably below normal this year, due to the extended rainy season in the spring.

The following appointments have been made in the Bee-Culture Office of the Bureau of Entomology for the summer months: Mr. A. D. Shaftesbury to work on the aging of worker bees; Mr. Bruce Lineburg to work on the responses of worker bees to light; Mr. Bernard Kurrelmeyer to work on the transmission of lights of various colors through honeys, for the purpose of establishing color standards for extracted honeys; Mr. L. M. Bertholf to examine bees to determine whether the mite causing the Isle of Wight disease is present; Miss Effie Ross, Miss Margaret Swigart, Miss Winifred Hull and Mr. Paul Smith, temporary assistants. The first four named are graduate students at Johns Hopkins University.

Department Of Insecticides

It is planned to review in a brief way, from month to month, the progress in insect control, and especially to record the new insect controls and new insecticides. The object is to place this information in a concise form before entomologists as promptly as possible since it is becoming difficult for those interested in insect control problems to keep in constant touch with the newer discoveries. It is hoped that we may utimately standardize, as far as is practicable, the control measures and particularly formulas of standard insecticides. The need of such a standardization was recently called to our attention when we had occasion to examine many publications containing insecticide formulas.

Authors are requested to promptly send to the undersigned all papers giving information on new insect controls and insecticides.

The past year has been noteworthy for progress, or at least stimulation, in insecticide development. Probably no problem in control by insecticides has received as much unusual attention and interest as the dust insecticides, particularly the comparative value of dust and liquid treatments and the use of nicotine dust. As a result several companies have placed on the market from 3 or 4 to 29 or more dusting combinations. Following the interest in dust insecticides there has been a corresponding progress in dusting equipment, resulting in the development of several unique and useful machines. It is impossible at this early date to predict the outcome. There are indications that dusting may find ausefulness in the control of insects and diseases attacking orchard crops, but there is a larger outlook and a more promising field for dust treatments in the control of vegetable crop pests.

The creation of the Plant Protection Institute and the untiring labors of its present chairman have played an important part in the interest in insecticides now being shown. It is hoped that this organization may continue to point the way and call to the attention of entomologists the need of investigations along various lines and especially to correlate the work being done in the various parts of the United States. Summer sprays for the control of scale insects is much needed at the present time, and reports being received daily illustrate the little we know as to the cause of summer injury by lime-sulphur and certain other summer sprays.

Publications have recently shown an interest in the development of paraffine oil sprays, both for dormant use and for summer applications.

There is need for studies on the further use of such prominent "special-use" insecticides as sodium fluoride and bichloride of mercury. The almost universal use of paradichlorobenzene for the control of the peach tree borer is evidence of the great need of underground fumigants. The calcium arsenate-gypsum control for the striped cucumber beetle, discovered by Messrs. Houser and Balduf is an achievement of great value. It might be of interest to note that Mr. H. A. Cardinell of the Missouri Extension Department, reports (Proc. Amer. Soc. for Hort. Sci., 1921, pp. 123-130) experiments against the striped cucumber beetle and observes that a mixture of one pound of arsenate of lead, ½ pound of Paris green, and 15 pounds of hydrated or air-slaked lime proved to be more effective against the cucumber beetles, was easier to apply, and gave less injury from burning, than did the calcium arsenate-gypsum mixture. Another insecticide, suggested several years ago by Dr. Wm. Moore, (Jour. Econ. Ent., vol. 11, June 1918, p. 341) but which seems not to have been given sufficient consideration by entomologists is nicotine oleate. In Indiana this insecticide has been tested by Mr. H. F. Dietz, and the writer, and results to date indicate its usefulness, particularly for greenhouse crops.

The subject of spreaders and adhesives is one of considerable interest to all entomologists and the unusual developments along this line the past year are very promising.

May 22, 1922 J. J. DAVIS

SUMMER MEETING OF THE ENTOMOLOGISTS OF THE NORTHEASTERN PART OF THE UNITED STATES

On July 26 to 28 the Entomologists of the northeastern part of the United States held a meeting in the western fruit section of New York State. On Wednesday morning about 18 autos left Lockport, N.Y., and toured thru fruit sections of Niagara, Orleans, Monroe, Wayne and Ontario Counties. This tour occupied two days and the results seen on dusting and spraying were highly valuable from an entomological standpoint.

Wednesday evening an informal get-together was held at the Seneca Hotel, Rochester. At this meeting Dr. D. N. Borodin of Russia gave a brief resumé of entomology and conditions as they exist in Russia today. Dr. Headlee, the chairman, appointed a nomination committee and Mr. Burgess reported on the coming annual meeting to be held in Boston in December, 1922.

Thursday evening a splendid banquet was held at the Seneca Hotel in Geneva. Some sixty persons attended. The chairman, Dr. T. J. Headlee called on C. P. Lounsbury of South Africa, who gave an informal discussion on the early and present day development of entomology in South Africa.

After this splendid talk the question of dusting for the control of insect pests was presented. The discussion was opened by Dr. W. Rudolfs of New Brunswick, N. J., who gave us some valuable chemical data on contact insecticides. This talk was followed by Prof. P. J. Parrot, who gave us a review of his wide experience in the control of various pests with dusts. After considerable discussion, the question was brought to a close and Dr. E. D. Ball was called on for a few remarks. He presented some important views on the trend of entomology and brought out some of its needs. His comments on the success attained in raising the salary of scientific workers connected with the government bureaus was encouraging.

The chairman concluded the meeting by calling for a report from the nomination committee. The following officers were nominated and elected to act for the coming year: Prof. G. W. Herrick, Ithaca, N. Y., as chairman, and M. P. Zappe, New Haven, Conn., as secretary.

Friday morning a tour was made through the experimental plats on the grounds of the Geneva Agricultural Experiment Station. From there a run was made to Ithaca where we lunched together and then visited the department of Entomology at Cornell University. We were also entertained by Dr. and Mrs. J. H. Comstock in their home.

All told the annual summer meeting was a decided success. All of those fortunate enough to attend, wish to express their appreciation of the manner in which the meeting was conducted. Many favorable comments were made on the splendid entomological work that is being conducted by entomologists in the state of New York.

The following attended the meeting: C. P. Lounsbury and wife, South Africa; A. L.Quaintance, Washington, D. C.; D. C. Heim, Sunbury, Pa.; G. E. Sanders, Louisville Ky.; T. J. Headlee, New Brunswick, N. J.; R. S. Slate, Chaumont, N.Y.; L. T. Barnes, Elmira, N.Y.; F. D. Gorton, Rochester, N. Y.; S. W. McNall Rochester, N.Y.; G. H. Wakeman, Middleport, N. Y.; D. E. Fink, Riverton, N. J.; B. H. Walden, New Haven, Conn., M.P. Zappe, New Haven, Conn.; P. Garman, New Haven, Conn.; A. J. Farley, New Brunswick, N. J.; W. Rudolfs, New Brunswick,N.J.; A. Peterson, New Brunswick, N. J.; M. Tower, Middleport, N. Y.; F. J. Sutton, Middleport, N. Y.; W. P. Hays, Frankfort, Ind.; H. Doane, Rochester, N. Y.; P. J. Parrott, Geneva, N. Y.; E. N. Cory, College Park, Md.; E. P. Felt, Albany, N. Y.; W. J. Schoene, Blacksburg, Va.; C. R. Crosby, Ithaca, N. Y.; J. B. Palmer, Ithaca, N. Y.; S. R. Hearns, Ithaca, N. Y.; H. Glasgow, Geneva, N. Y.; A. L. Pierstorff, Rochester, N. Y.; H. W. Fitch, Ithaca, N. Y.; G. E. Smith, Albion, N. Y.; H. E. Thomas, Ithaca, N. Y.; C. F. W. Muesebeck, Melrose Hlds. Mass.; C. W. Collins, Melrose Hlds., Mass.; G. F. MacLeod, Geneva, N. Y.; J. R. Stear, Chambersburg, Pa.; L. F. Strickland, Lockport, N. Y.; S. W. Harmon, Geneva, N Y.; T. T. Haach, North East, Pa.; D. M. DeLong, and wife, Columbus, O.; D. F. Barnes, Melrose, Mass.; P. T. Barnes, Harrisburg, Pa.; T. L. Guyton, Harrisburg, Pa.; F. L. Holdridge, Lancaster, Pa.; F. J. Welb, Barker, N. Y.; A. F. Burgess, Melrose Hlds, Mass.; E. D. Ball, Washington, D. C.; D. N. Borodin, Russia, F. Z. Hartzell, Fredonia, N. Y.; H. E Hodgkiss, State College, Pa.; J. L. Horsfall, Philadelphia, Pa.; S. W. Frost, Arendtsville, Pa.; M. D. Leonard, New York City.; W. A. Ross, Vineland Station, Ontario.; B. A. Porter, Washington, D. C.; and G. W. Herrick, Ithaca, N. Y.